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ABSTRACT

This self-instructional booklet is designed to enable public health workers identify larvae of some important North American mosquito species. The morphological features of larvae of the various genera and species are illustrated in a programed booklet, which also contains illustrated taxonomic keys to the larvae of 11 North American genera and to 41 of the important species. A glossary and a short bibliography are included. (AL)

EDO 45443

DEVELOPMENTAL

WORKBOOK ON THE IDENTIFICATION OF MOSQUITO LARVAE

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE -
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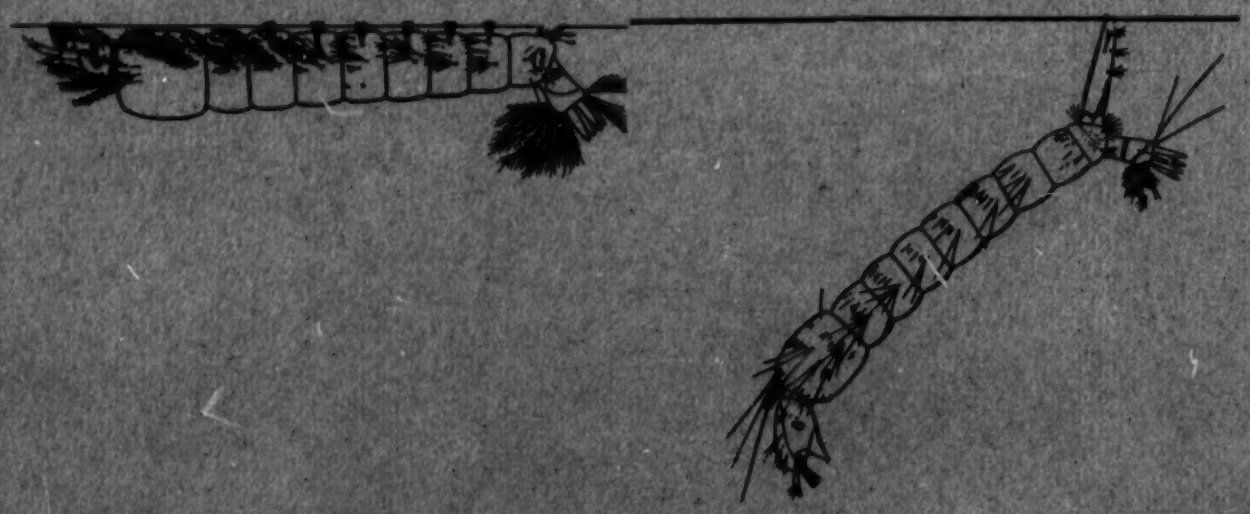

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
CONSUMER PROTECTION AND ENVIRONMENTAL HEALTH SERVICE
Environmental Control Administration
Bureau of Community Environmental Management
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WORKBOOK ON THE IDENTIFICATION OF MOSQUITO LARVAE

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1969

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INTRODUCTION

One of the most important aspects of pest mosquito and mosquito-borne disease control programs is the accurate identification of mosquito larvae. Surveys are necessary to determine important species and to locate and delimit their breeding places before planning any draining or filling operations, other types of source reduction or the proper application of insecticides with hand, power, or aerial equipment. The accurate determination of mosquito larvae is obviously of utmost importance in making such an assessment.

This manual is based on the experience of many members of the Public Health Service in teaching basic mosquito taxonomy during the past 25 years. The first 3 parts incorporate many of the ideas and illustrations in PHS manuals, pictorial keys, filmstrips and motion pictures in a new workbook format: trying to involve the student in a learning, recall and answering method of teaching. Part I deals with the basic differences between anopheline and culicine larvae. Part II is concerned with the detailed morphology of mosquitoes used in identification. Part III deals with the generic characteristics of the 11 genera of North American mosquito larvae. Part IV is a quiz. Part V is an illustrated key to some 39 of the more important species of mosquitoes in North America, the ones that teachers often have available in quantity. This work book should be useful in teaching students both the method of using a key and the identifying characteristics of many important species. It should also be helpful to technicians at many Mosquito Control Districts in identifying the common and important species.

HOW TO USE THIS BOOKLET

The purpose of this self-instructional Work Book is to teach, not to test. It has been specially written so that you can learn by doing. Parts I, II, and III can be completed with a pencil, each student setting his own pace, taking whatever time is necessary. Read each page carefully. Write in the answers as you work through the Work Book and compare your answers with those in the Answer Book.

REMEMBER

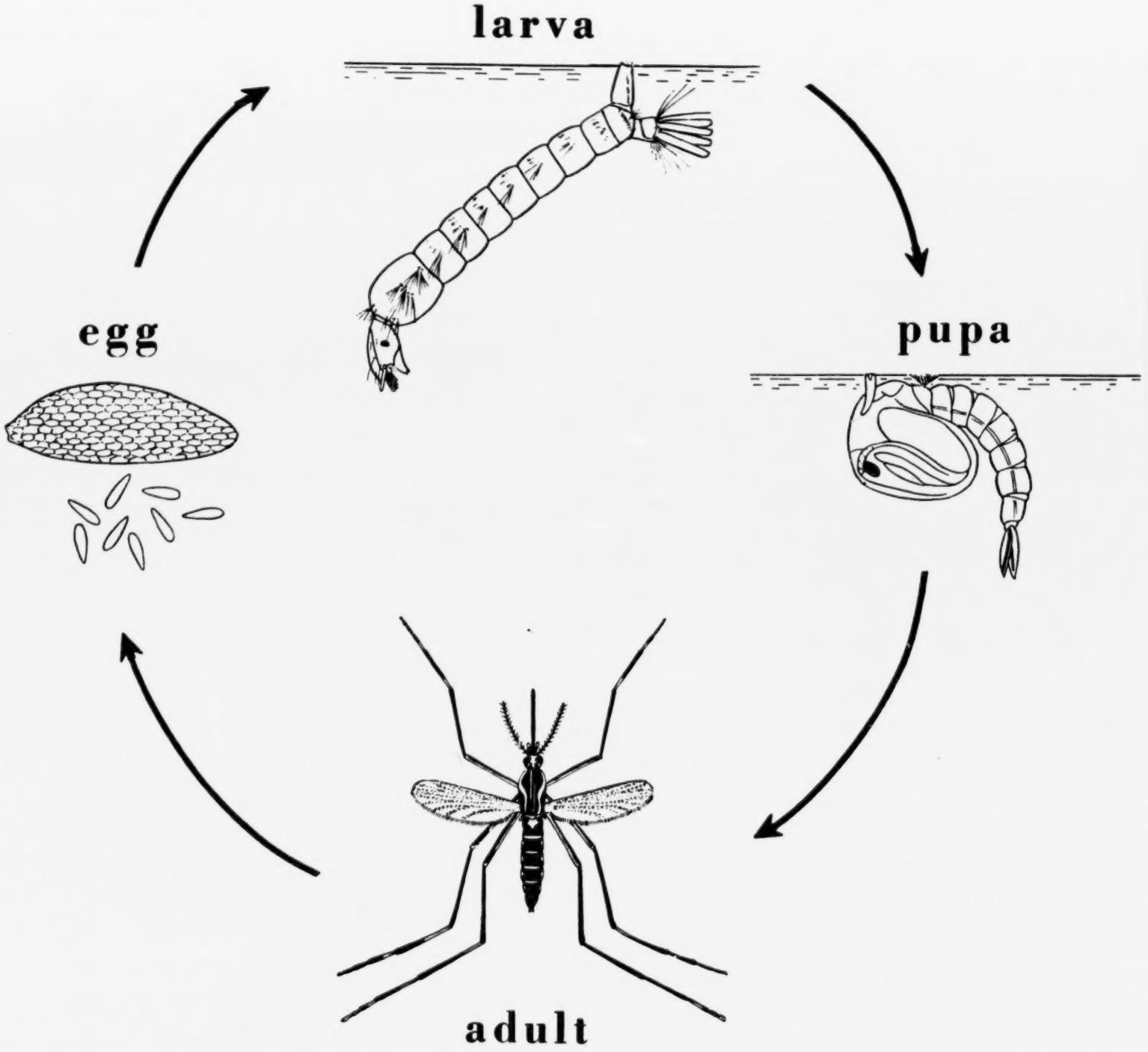
--Read EVERYTHING carefully, more so than you ordinarily do.
--Work through each paragraph and page ONE STEP AT A TIME.
--Do your best to answer all the questions BEFORE you look back or use the answer book.

When you have completed Parts I, II, and III, use a microscope and the illustrated key in Part V to identify specimen mosquitoes, which your instructor will provide.

PART I

What is an Anopheles or a Culicine Larva?

There are four stages in the life history of mosquitoes:



The first three stages are aquatic; the fourth, or adult stage, is aerial.

In most species the adult females, but not the males, are bloodsucking.

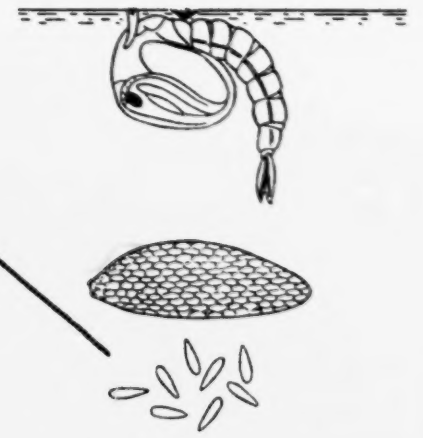
TEST YOURSELF: Draw a line from each name to the appropriate drawing.

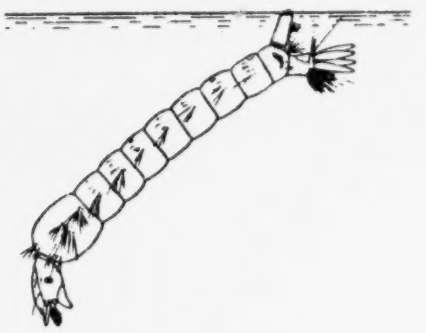
1. egg

2. larva

3. pupa

4. adult



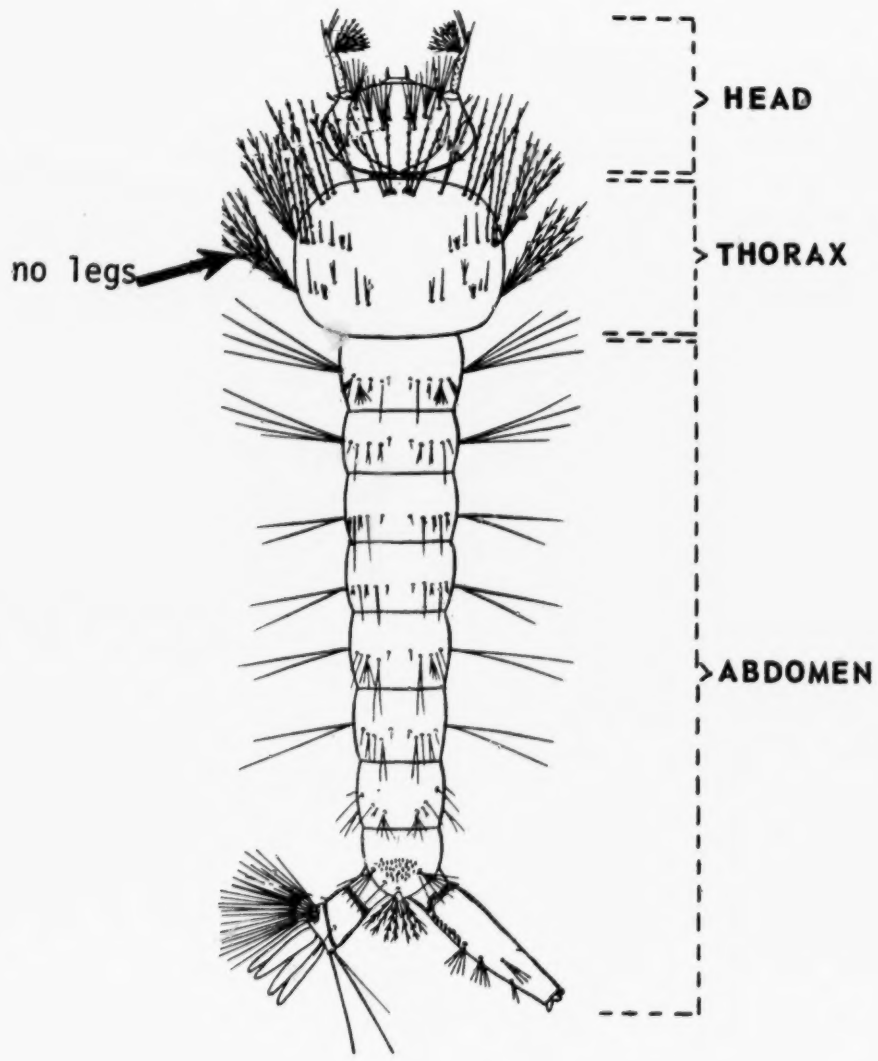


Mosquito larvae can be distinguished from all other aquatic insects by a combination of two characters:

1. They have no legs,

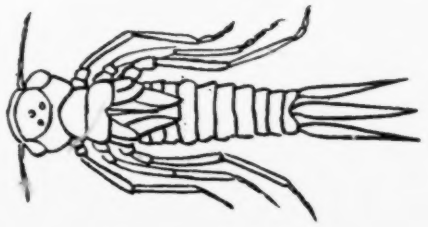
   and

2. The thorax is wider than the head or abdomen.

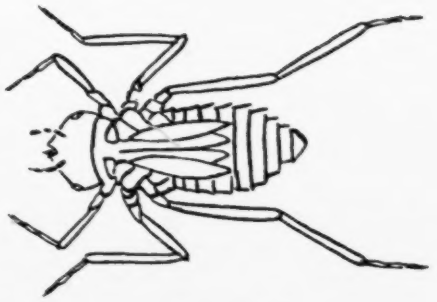


These are not mosquito larvae but are found commonly in collections of standing water.

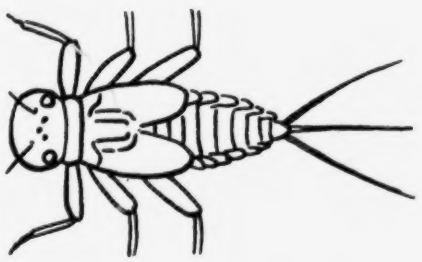
These aquatic insects have legs on the thorax.



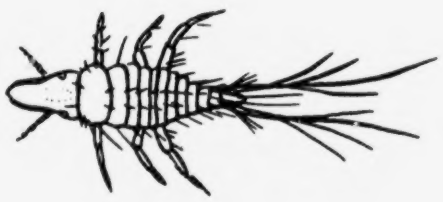
DAMSEL FLY



DRAGONFLY

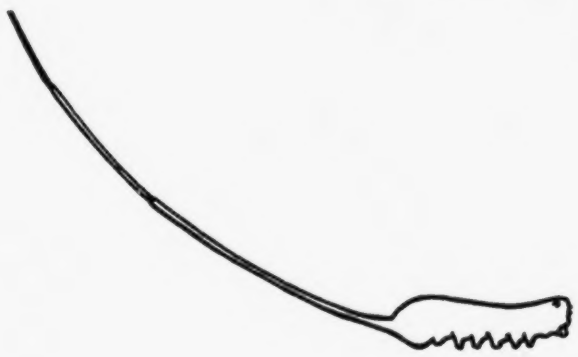


MAY FLY

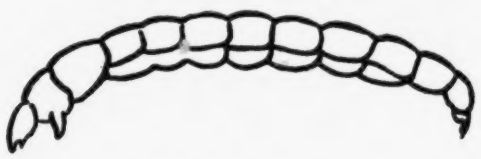


BEETLE

These aquatic insects have the thorax about as wide as the head and abdomen.

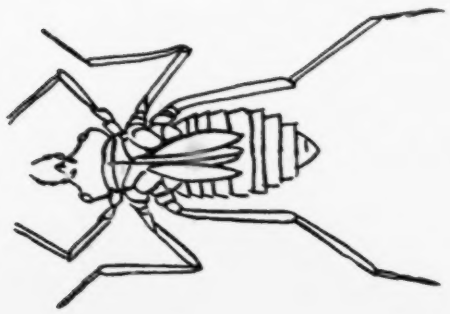


RAT-TAILED MAGGOT

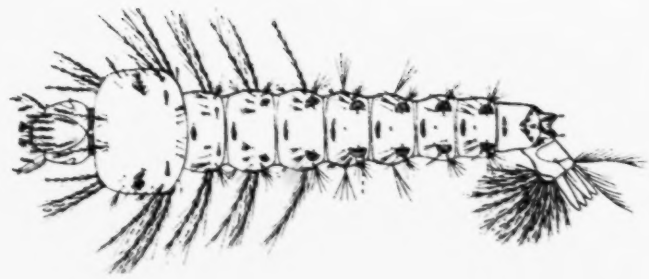


MIDGE LARVA

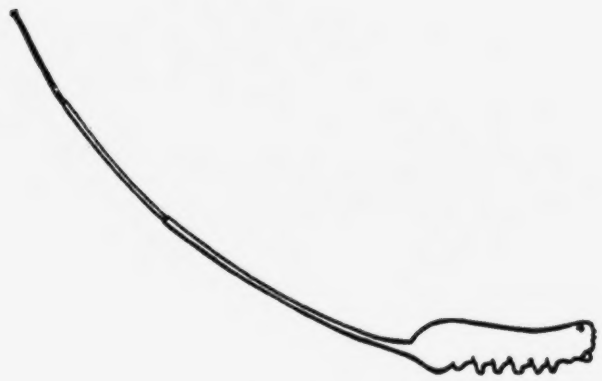
TEST YOURSELF: Circle the numbers of the specimens illustrated below that are mosquito larvae.



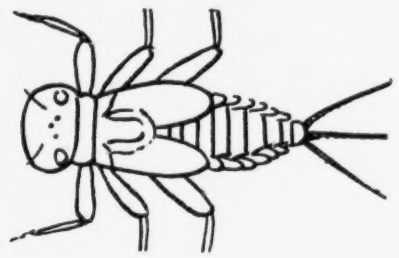
1.



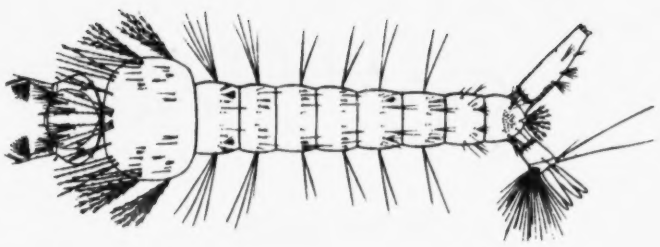
2.



3.



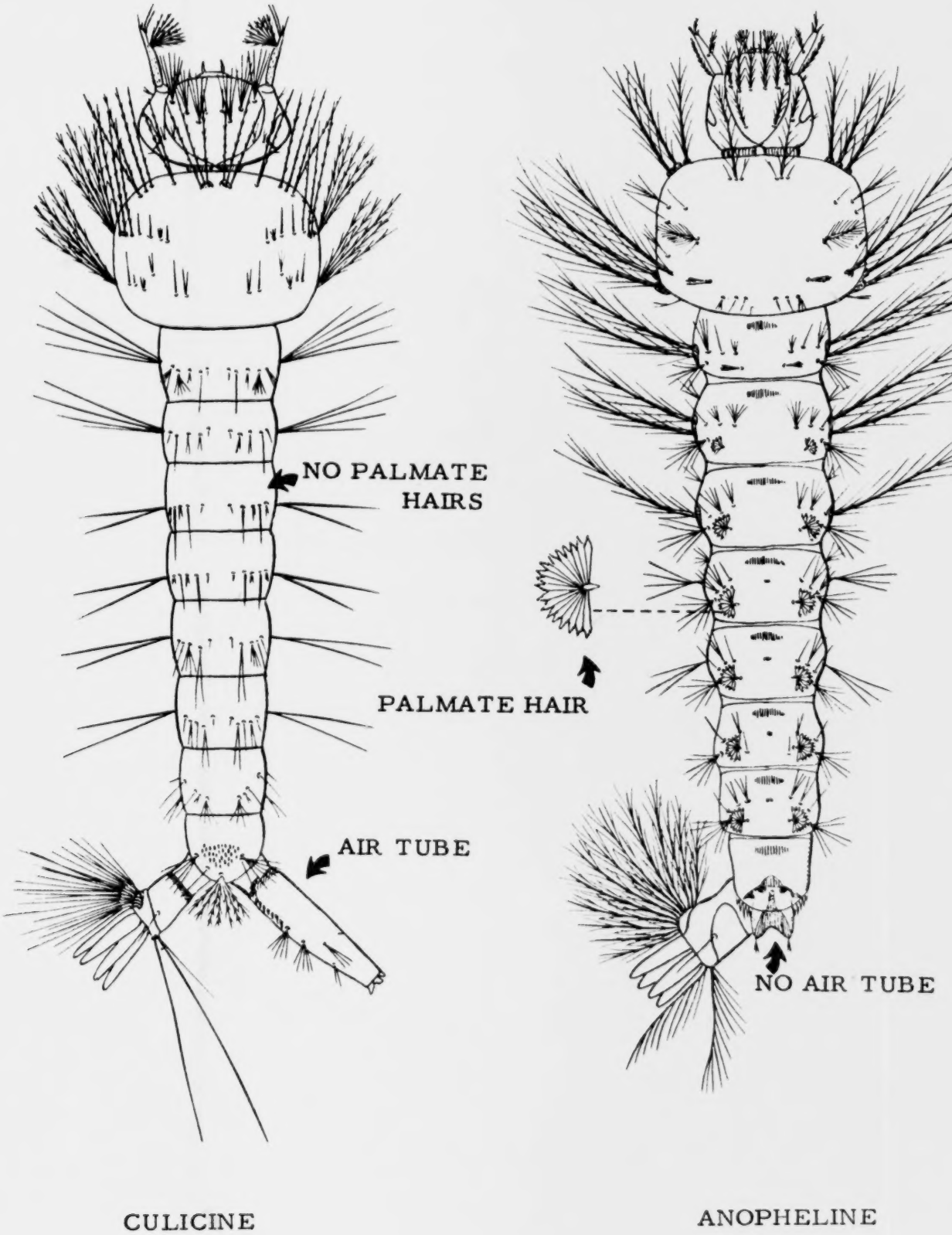
4.



5.

6.

Mosquitoes are divided into two main types known as "anopheline" or "culicine." An anopheline mosquito larva has palmate hairs and no air tube; a culicine mosquito larva has no palmate hairs but does have an air tube.

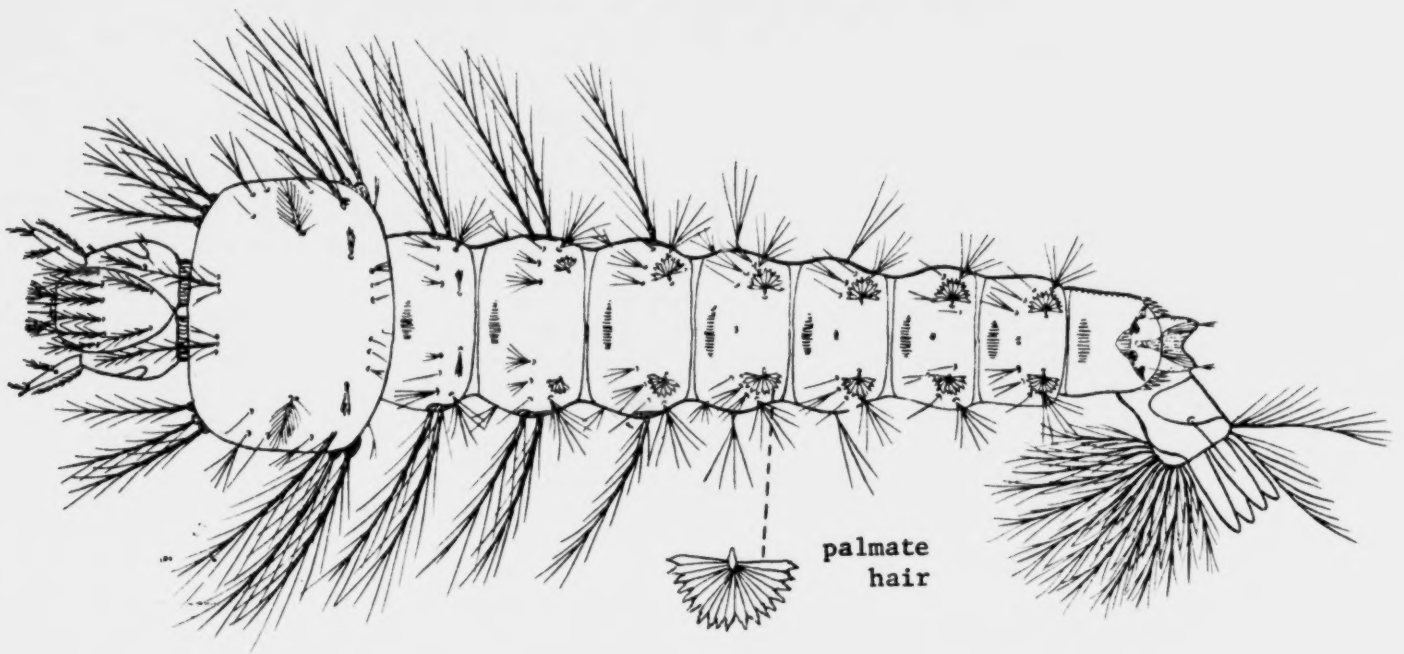


CULICINE

ANOPHELINE

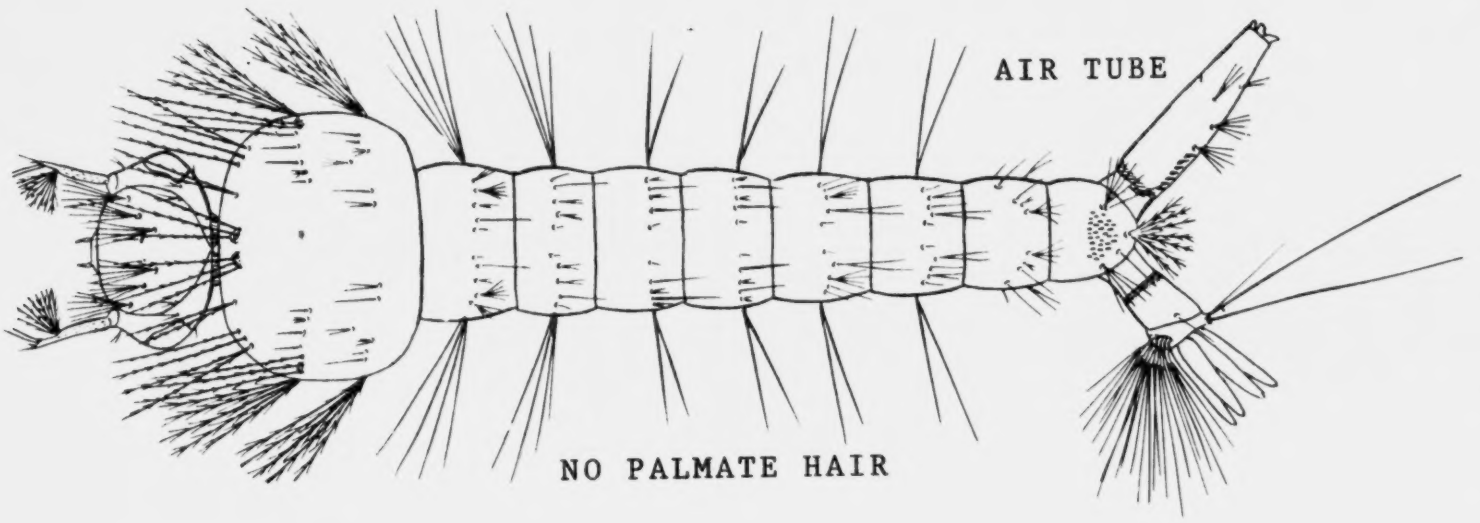
The palmate hairs (after the palm of the hand or a palm frond) are palm-shaped structures present on the abdomen of anopheline larvae and absent in culicine larvae.

AIR TUBE ABSENT; ABDOMEN WITH PALMATE HAIRS



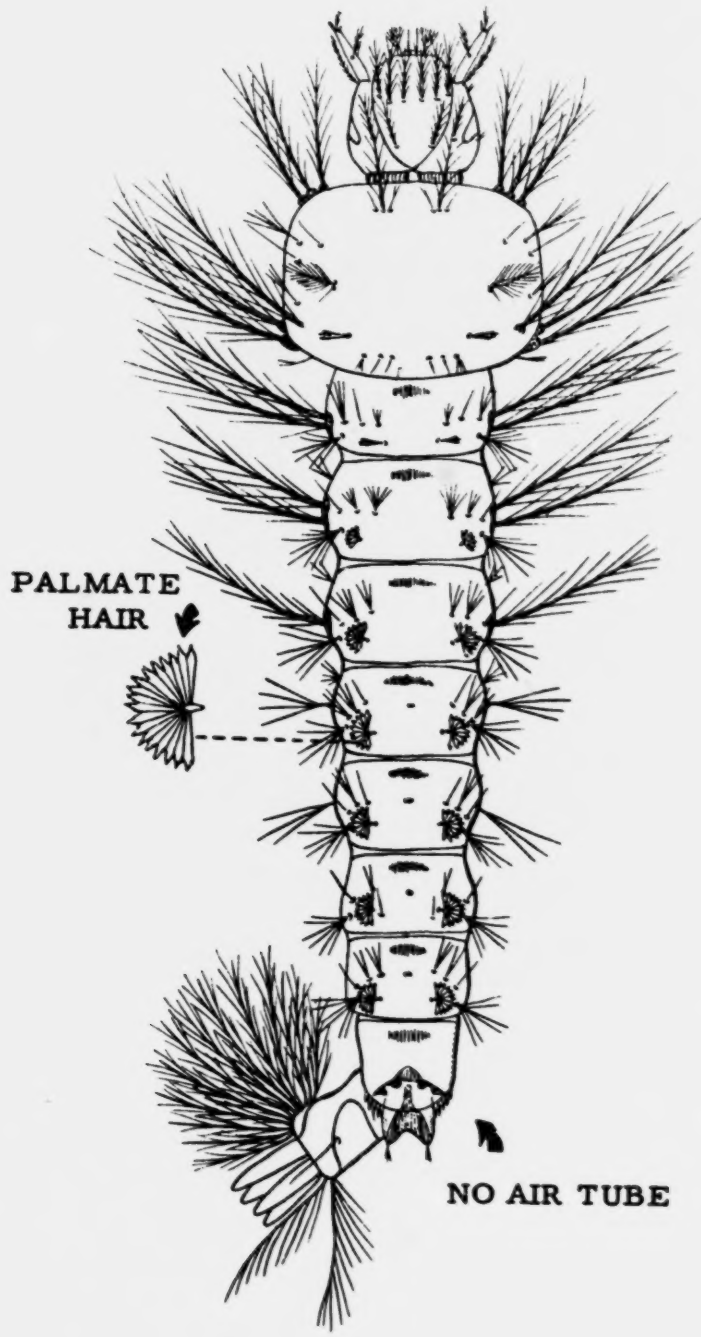
The air tube is a cylindrical structure arising from the eighth abdominal segment. It is present in the culicine larvae but absent in the anopheline larva.

AIR TUBE PRESENT; ABDOMEN WITHOUT PALMATE HAIRS



The malaria mosquito belongs to the group, or genus (plural - genera), named Anopheles.

The term "anopheline" is derived from this name. Study the anopheline larva pictured here.



MALARIA MOSQUITO LARVA

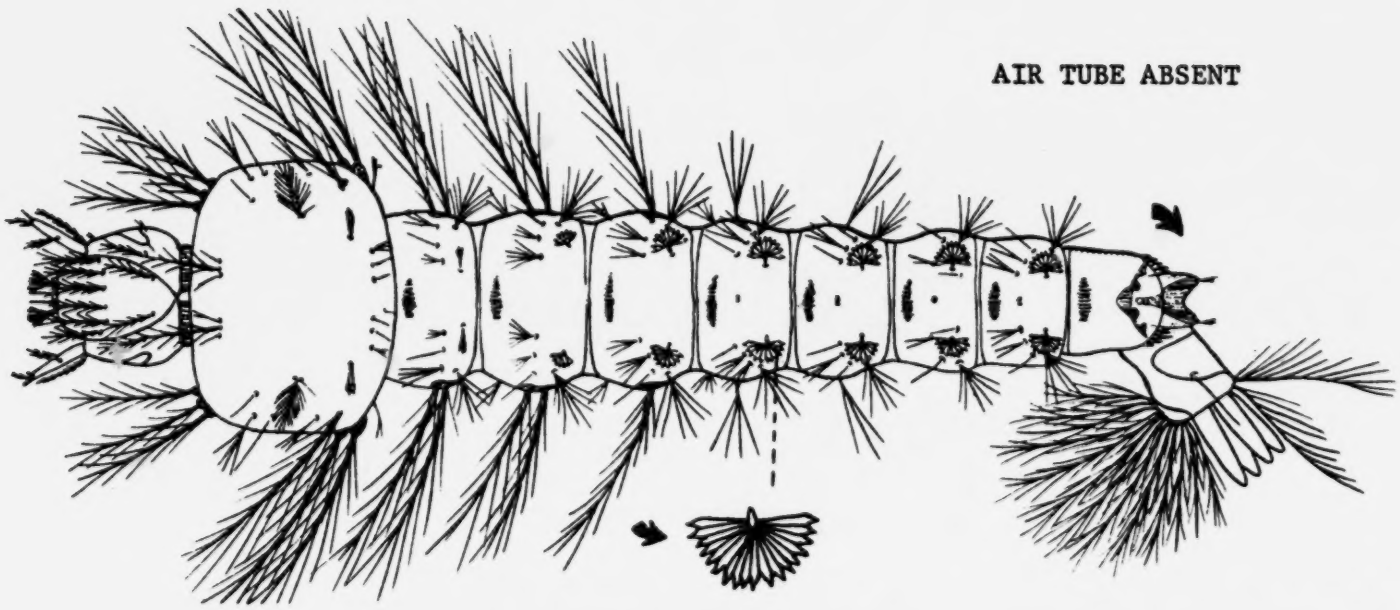
Anopheles = "anopheline" mosquito larva

Remember these three facts to identify an anopheline, or malaria-mosquito larva:

1. When resting, it lies parallel to the water surface.
2. It has no air tube.
3. It has palmate hairs which help keep the abdomen at the water surface.

Water Surface

ABDOMEN WITH PALMATE HAIRS



PALMATE HAIR

TEST YOURSELF: Mark out the wrong statement in (a) and (b).

The malaria mosquito larva can be recognized in the field with the naked eye, for it

(a)
Hangs from the water surface.

Lies parallel with the water surface.

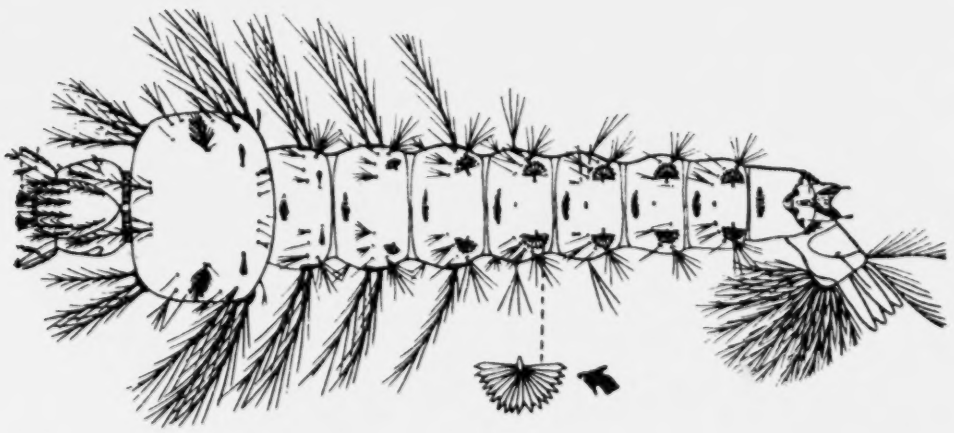
(b)
Has an air tube.

Does not have an air tube.

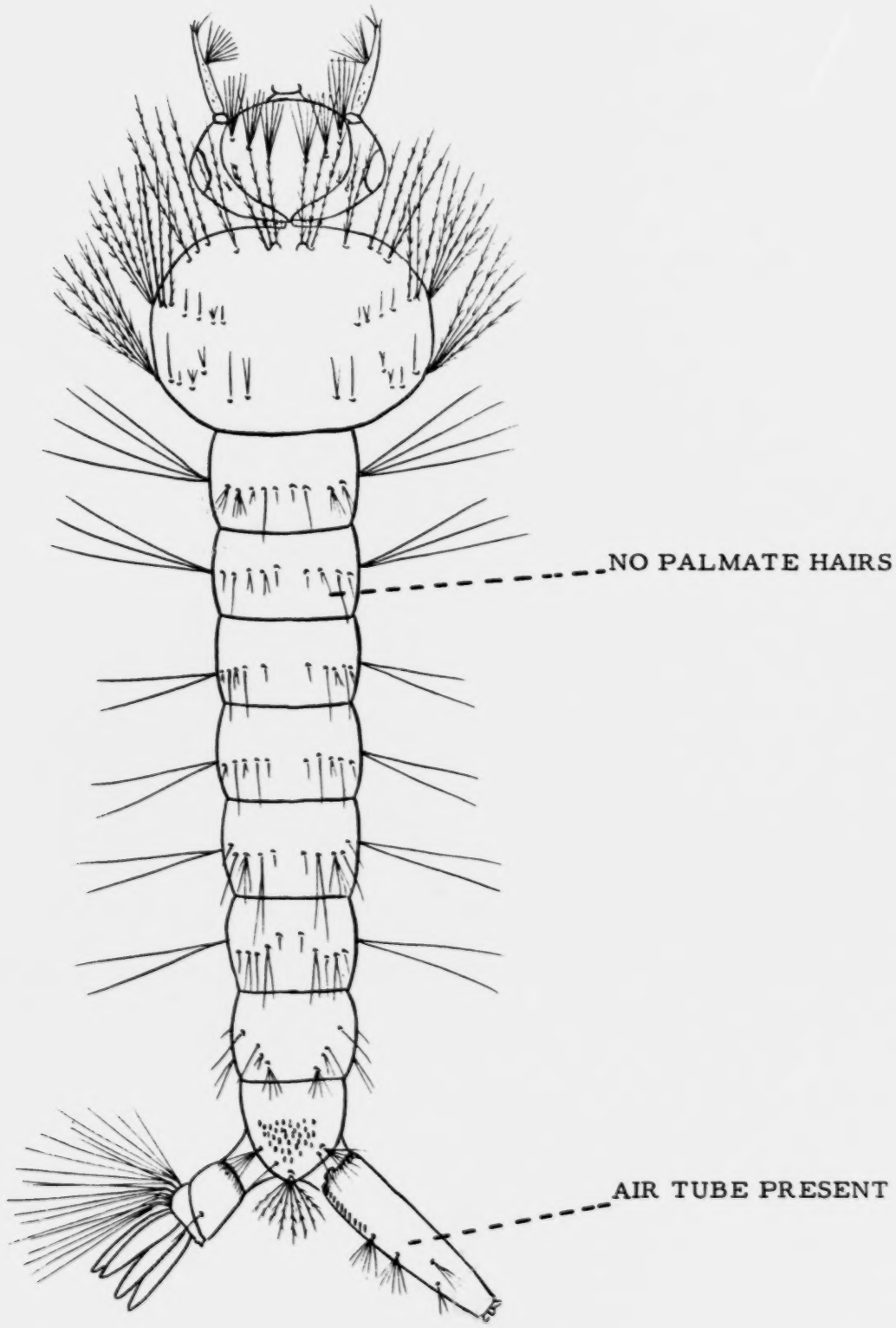
Water Surface

Fill in the blank in the statement below:

In the laboratory, with the aid of a microscope, you can see palm-shaped structures, called _____, on some of the abdominal segments.



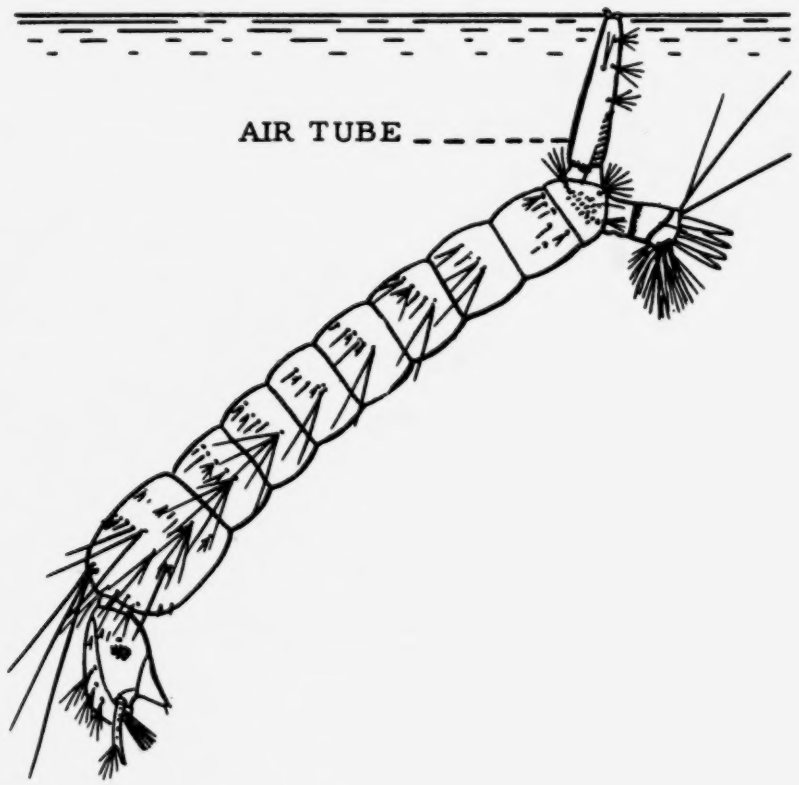
The term "culicine" mosquito comes from the genus named Culex, a well-known genus of pest mosquito. Study this drawing of a culicine larva.



CULICINE (PEST) MOSQUITO LARVA

These characteristics will enable you to identify the larva of a culicine, or pest mosquito.

1. It hangs at an angle to the water surface.
2. It has an air tube.
3. It does not have palmate hairs.

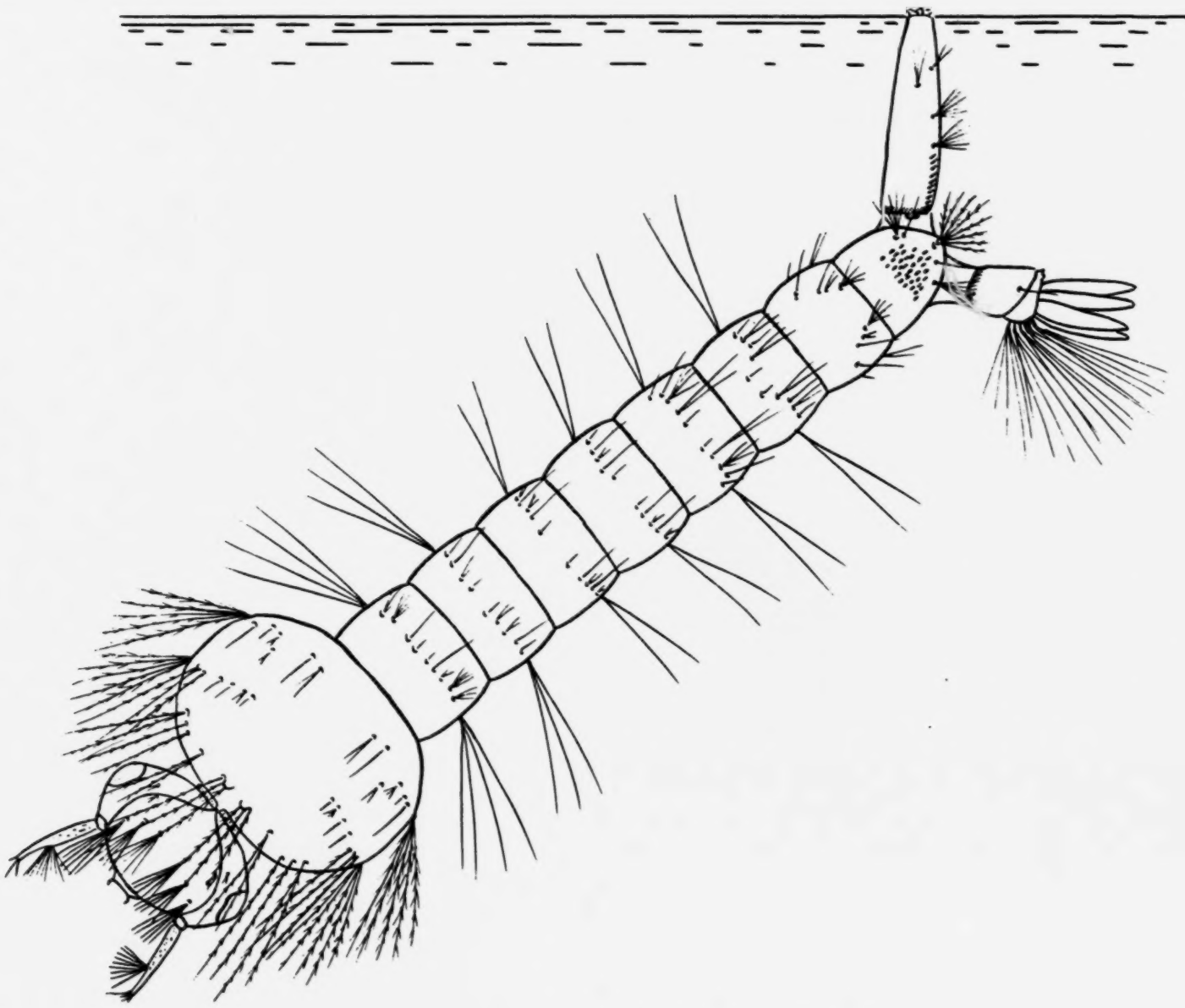


TEST YOURSELF: Culicine larvae can be identified by three characters:

1. _____

2. _____

3. _____



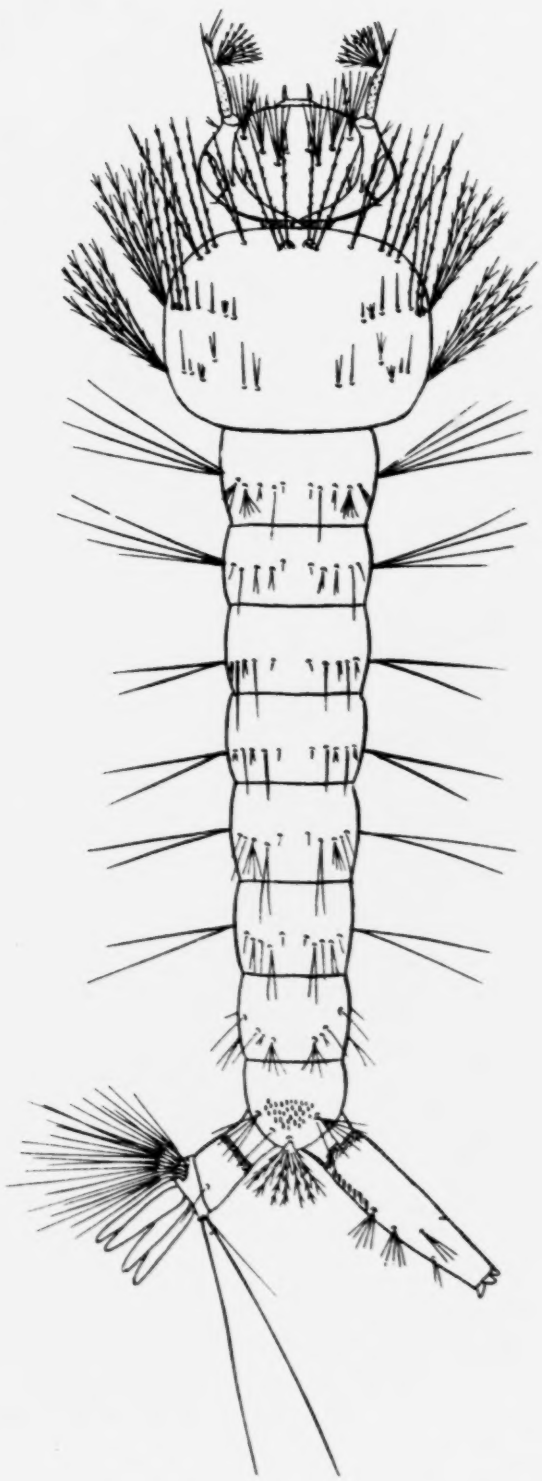
TEST YOURSELF: The two important types of mosquito larvae are called:

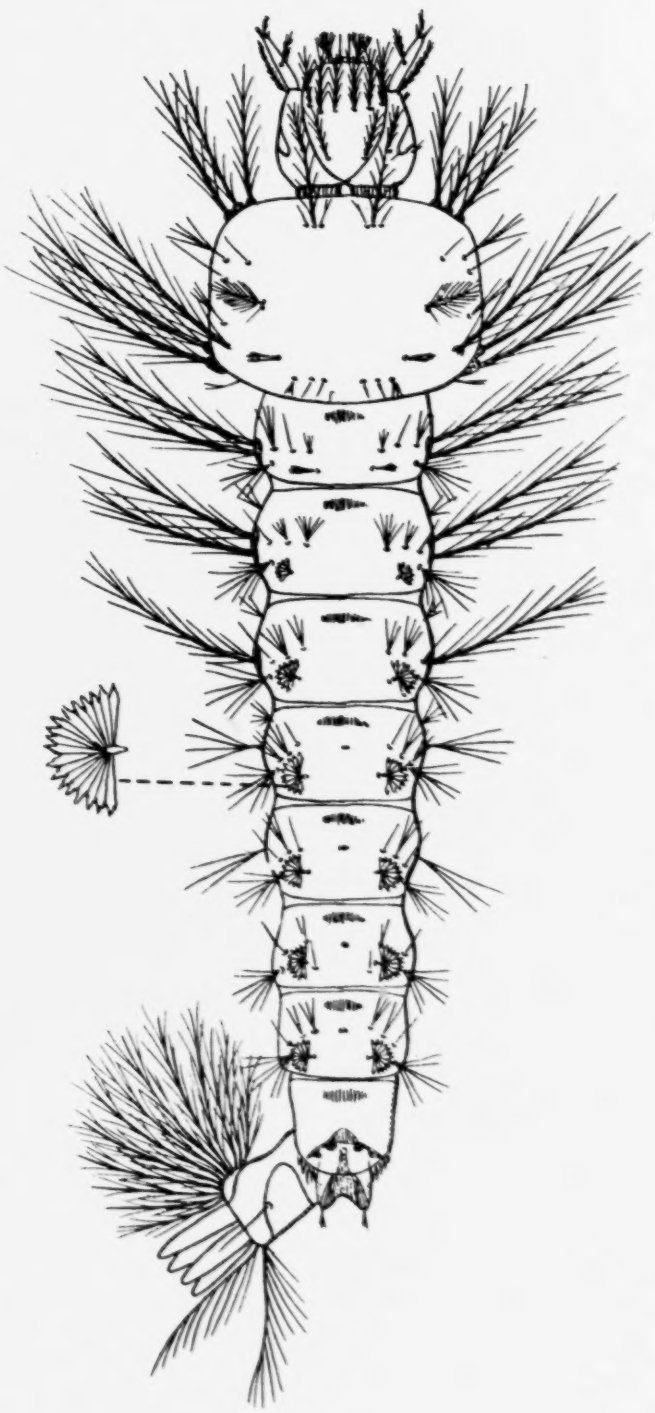
1. _____ or _____

2. _____ or _____

Write the appropriate names over the larvae pictured.

_____ _____



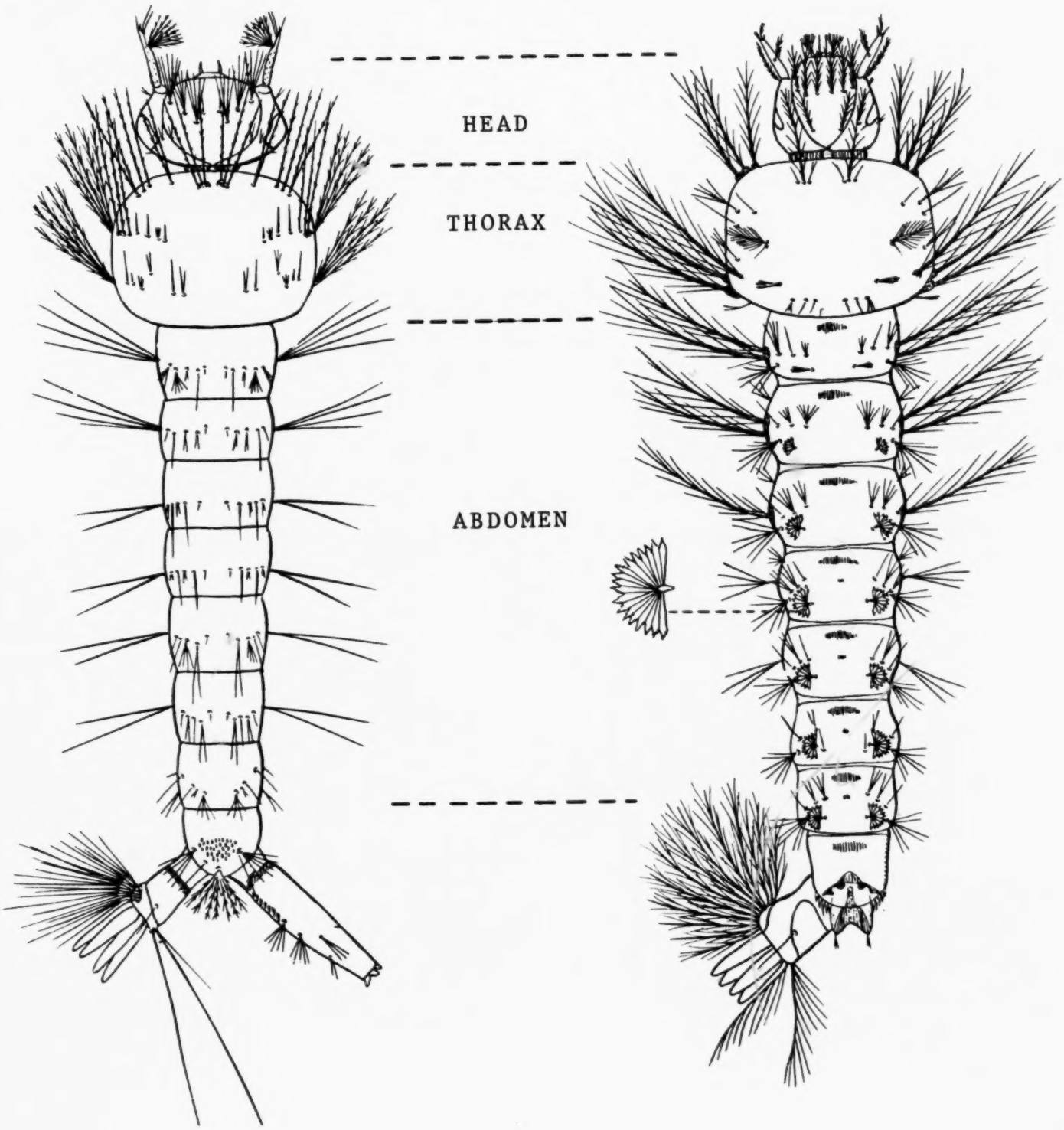


PART II

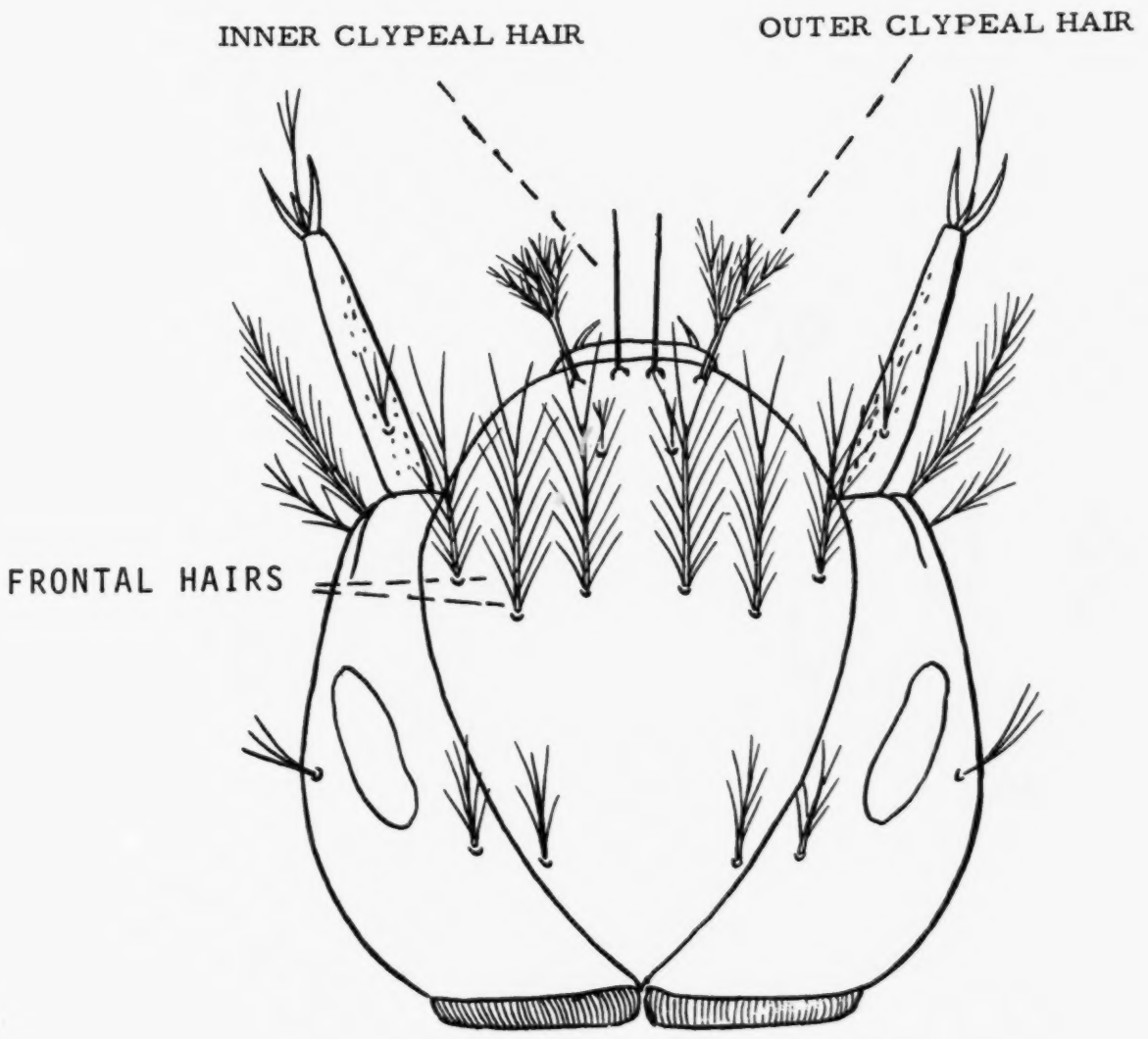
Morphology of Mosquito Larvae

The mosquito larva is divided into three body regions: <u>head</u>, <u>thorax</u>, and <u>abdomen</u>.

Structures on each of these body regions are used in identifying mosquito larvae.



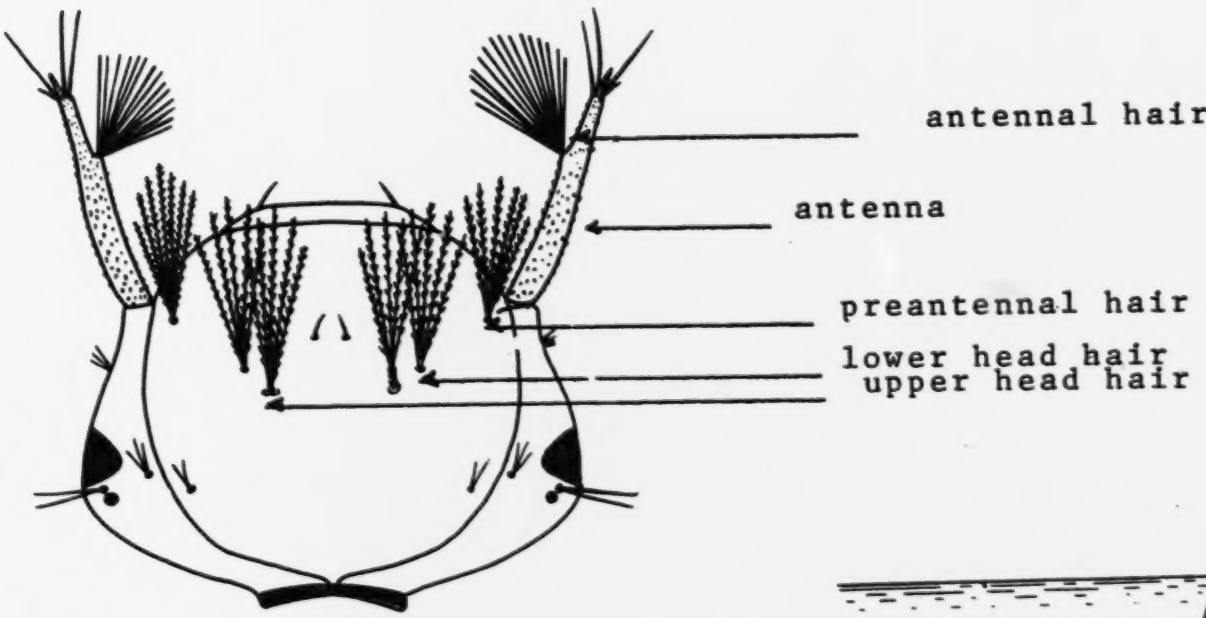
The head of an anopheline larva is very different than that of a culicine larva. It is longer than wide with six frontal hairs across the frontal area (the middle of the dorsal or upper surface) and four hairs on the anterior end, called the inner and outer clypeal hairs.



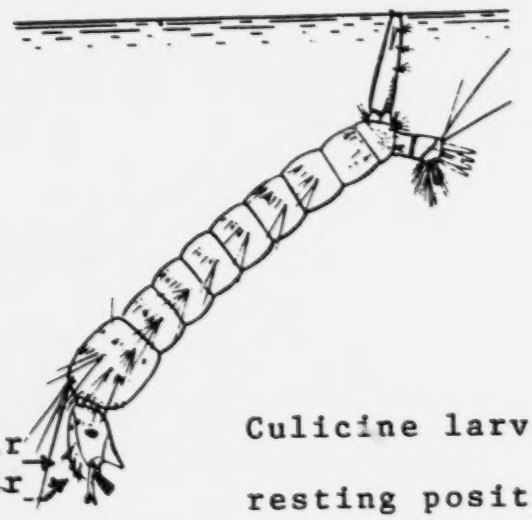
Head of anopheline larva

The head of all North American culicine larvae (except Uranotaenia) is as wide as, or wider than, long. The important hairs across the middle of the dorsal surface of the head are called the upper head hair, lower head hair, and preantennal hair.

Observe in the drawings the relative positions of the upper and the lower head hairs. In drawing A, the lower head hair appears to be in an uppermost position, but in drawing B, which shows the live larva hanging suspended from the water surface, the lower head hair is below the upper head hair.

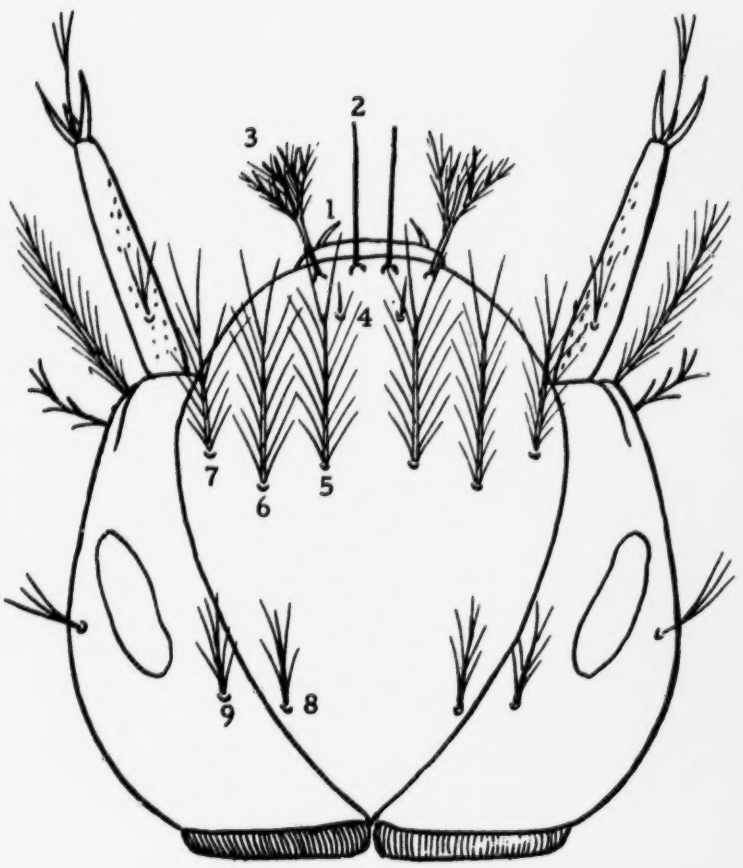


A. Head of culicine

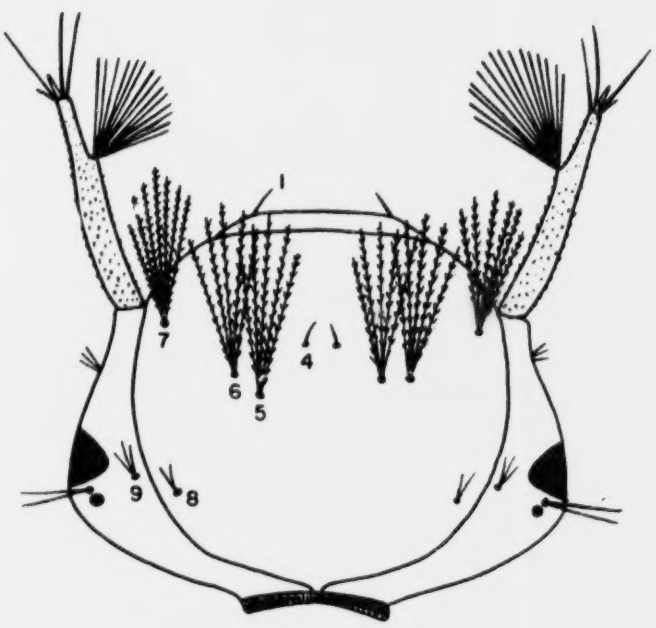


B. Culicine larva in resting position

The head hairs are all numbered. Some workers, and some identification keys, refer to the hairs by numbers rather than by names. The hairs are listed below by both number and name.



Anopheles

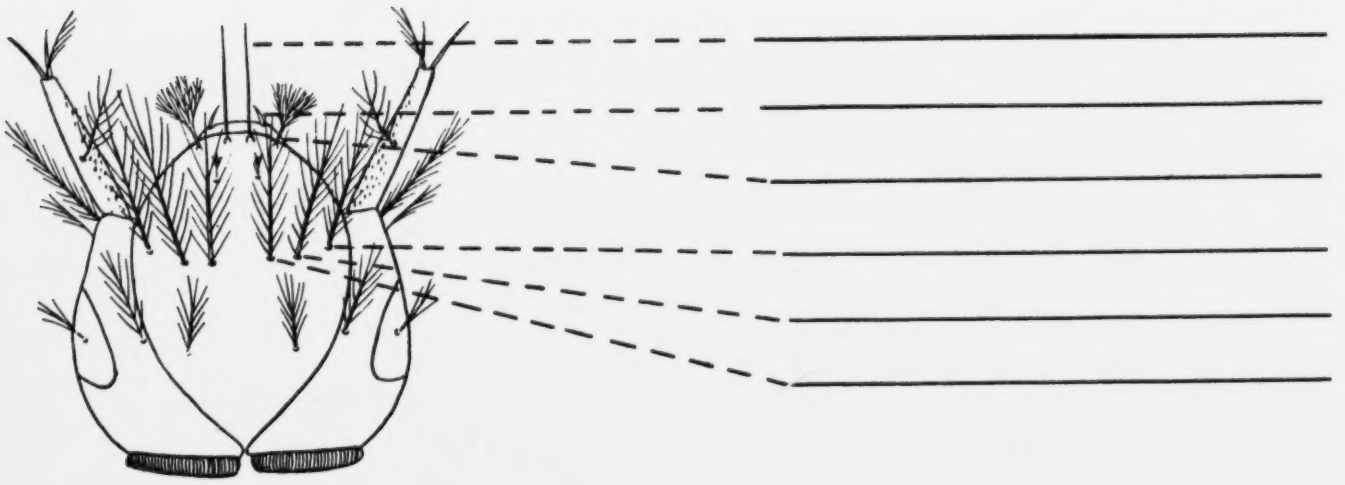


Culex

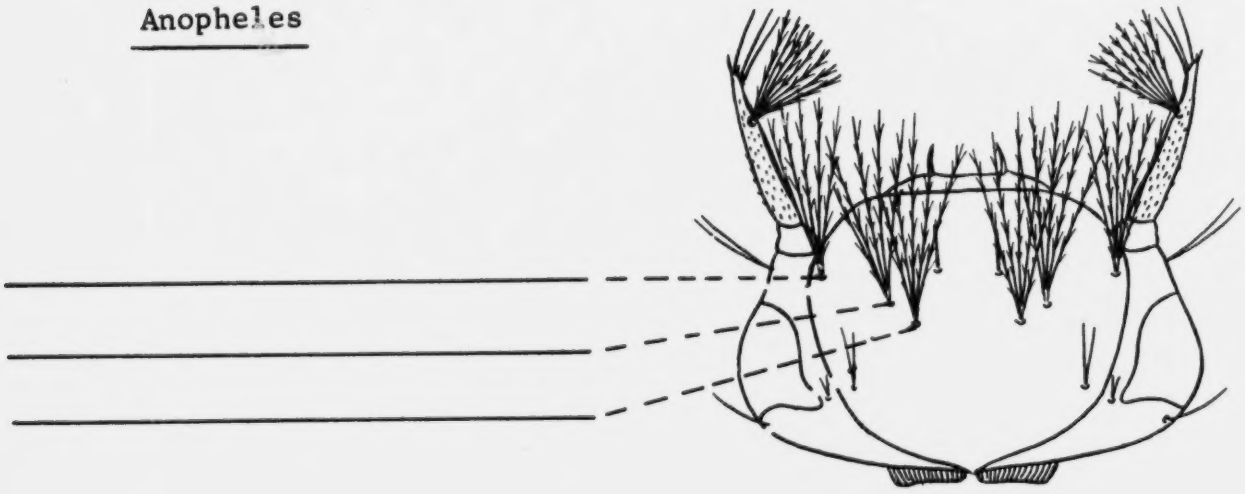
1. preclypeal
2. inner clypeal
3. outer clypeal
4. postclypeal
5. inner frontal in anophelines; upper head in culicines
6. mid-frontal in anophelines; lower head in culicines
7. outer frontal in anopheles; preantennal in culicines
8-9. sutural (occipital)
8. sutural (inner)
9. trans-sutural

NOTE: Hairs 2 and 3 are absent in culicines

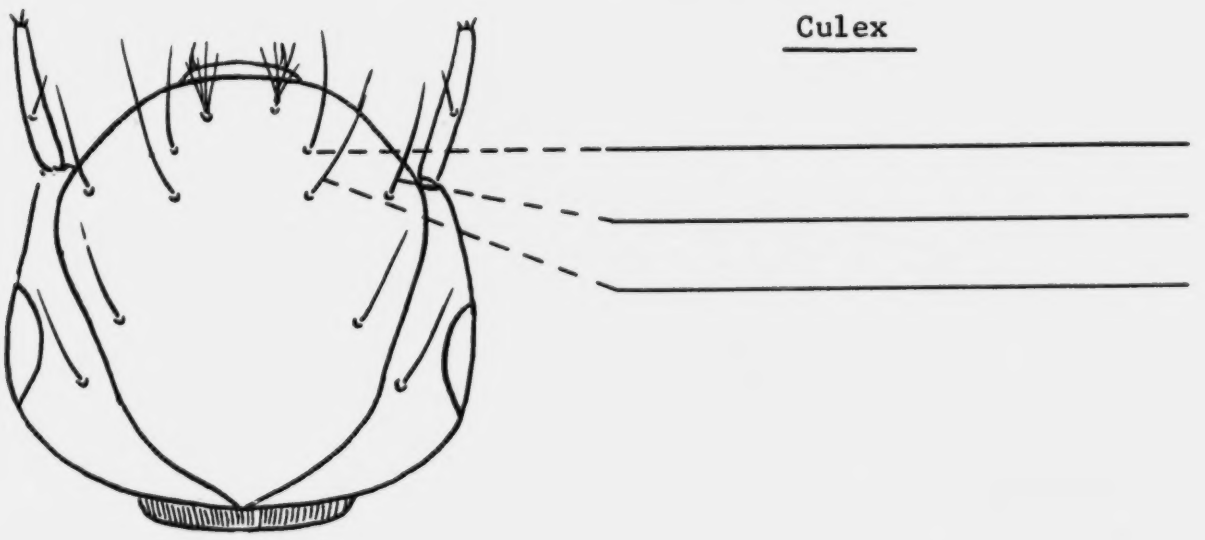
TEST YOURSELF: number and label the hairs on the dorsal (or upper) surface of the head.



Anopheles

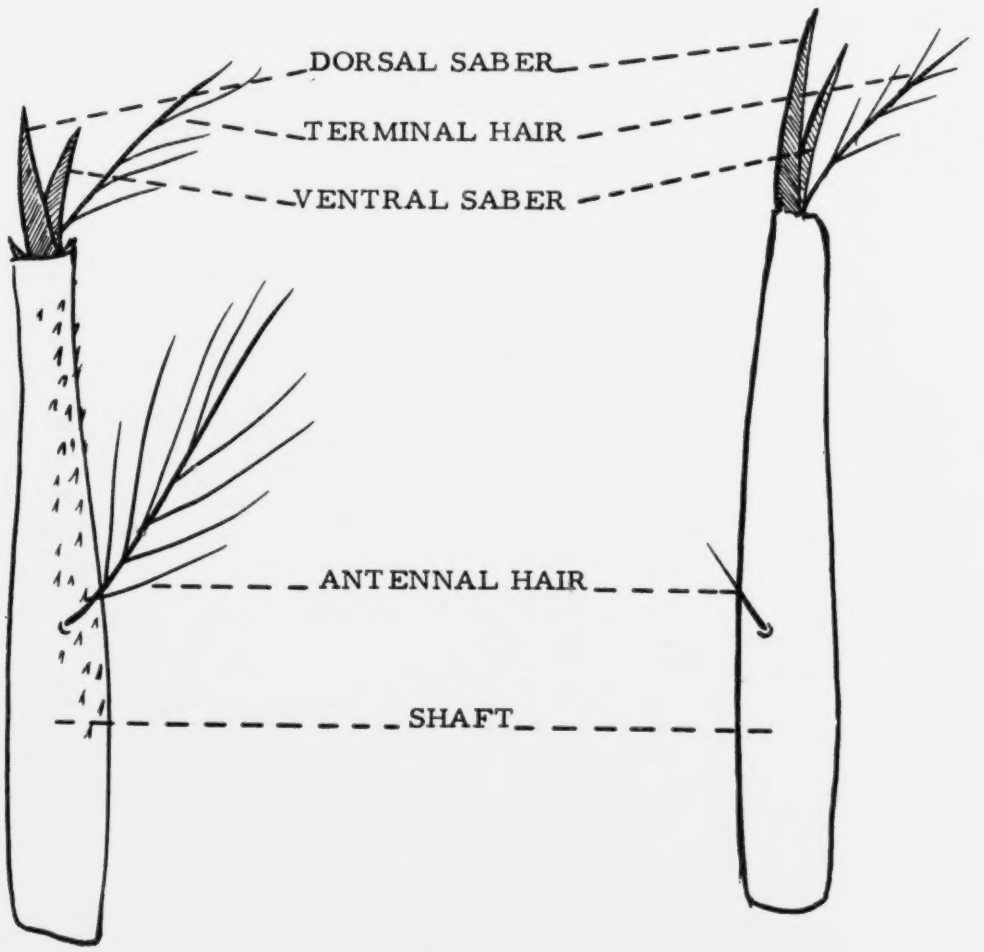


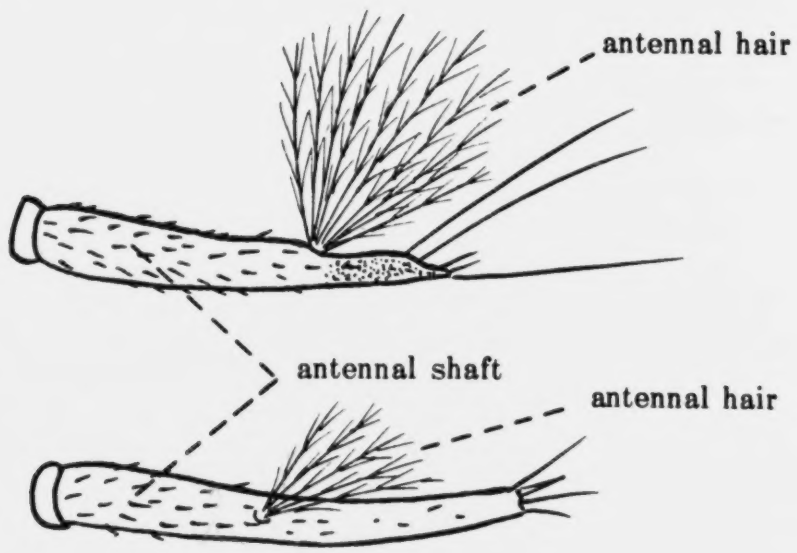
Culex



Aedes

The antenna consists of a tubular shaft bearing an antennal hair, a terminal antennal hair, and, at the tip, a dorsal and ventral saber. The antennal hair may be single or branched. Its position on the shaft is important; it may be located at the middle, or at some other part. The antennal hair may be on the inner side of the shaft, that is, toward the clypeal hairs, or on the outer side or dorso-external surface. The shaft is smooth, spicular or spinose.





The antenna has distinctive characteristics that are useful in identifying each species of mosquito.

TEST YOURSELF: Match one of the numbered descriptions with the corresponding drawing.

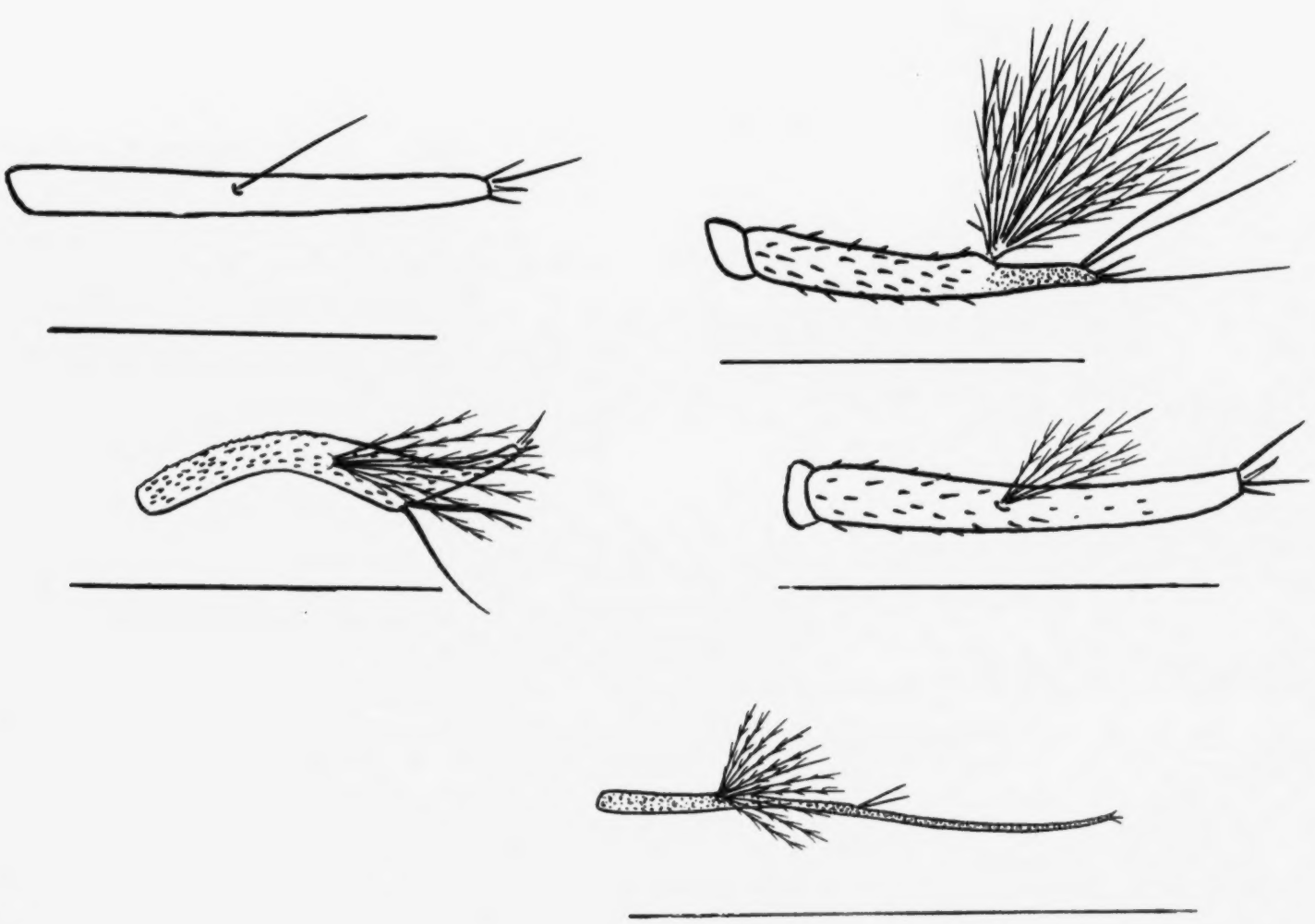
1. Most species of Culex have the basal third of the antennal shaft stout, the apical third noticeably more slender with the antennal hair many-branched.

2. Aedes aegypti, Aedes triseriatus and Aedes sierrensis have the antennal shaft smooth and a single antennal hair.

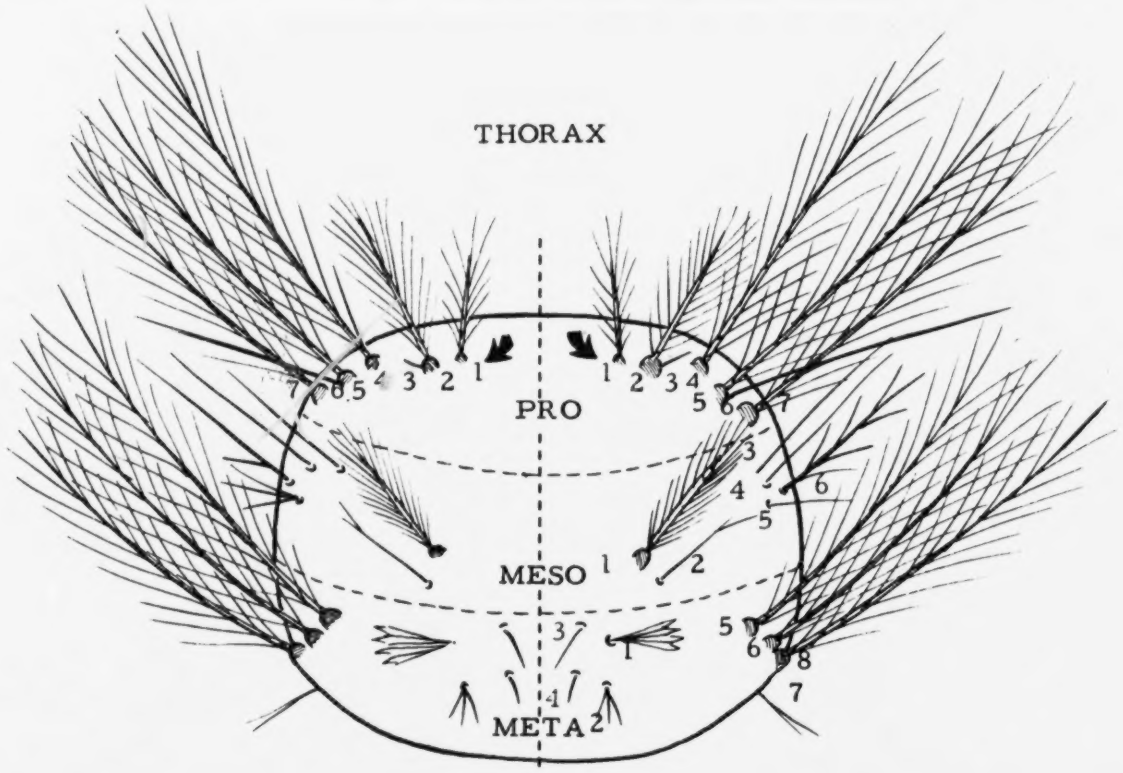
3. Most Aedes have the antennal shaft somewhat rough and a 2- to many-branched antennal hair.

4. Mansonia has the apical part of the antennal shaft very slender.

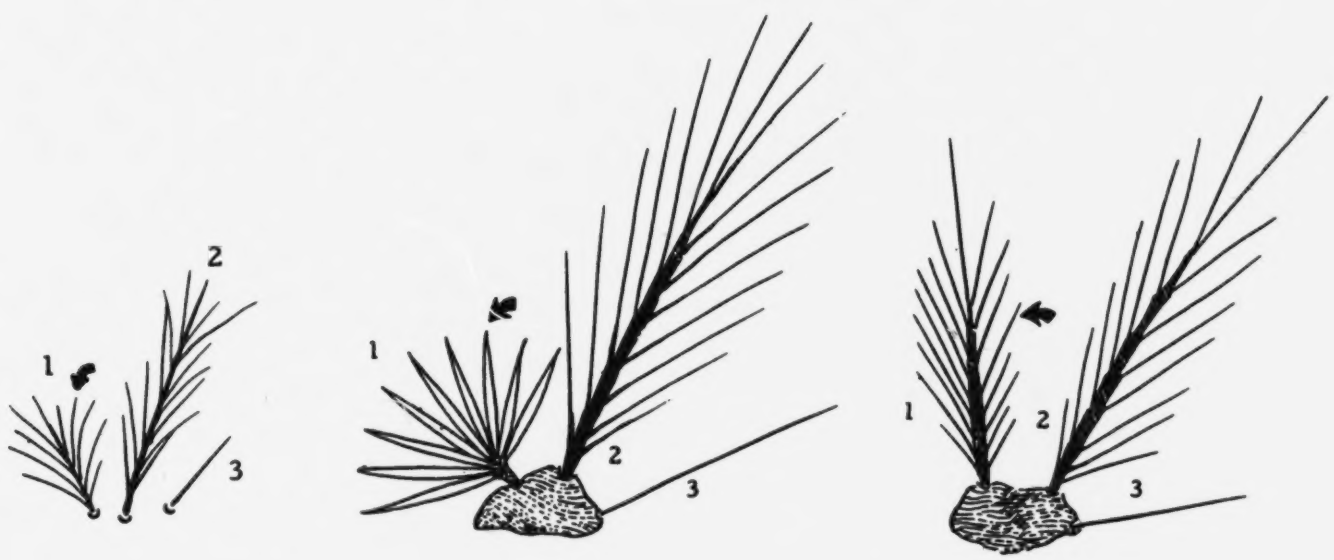
5. Psorophora discolor has the antennal shaft noticeably expanded.



The second body region of the mosquito is called the thorax. The thorax is a compound structure resulting from the fusion of three segments known as the prothorax, mesothorax, and metathorax. The hairs on the thorax are numbered, those on the prothoracic and mesothoracic parts with numbers beginning at the median dorsal line as shown in the drawing below.



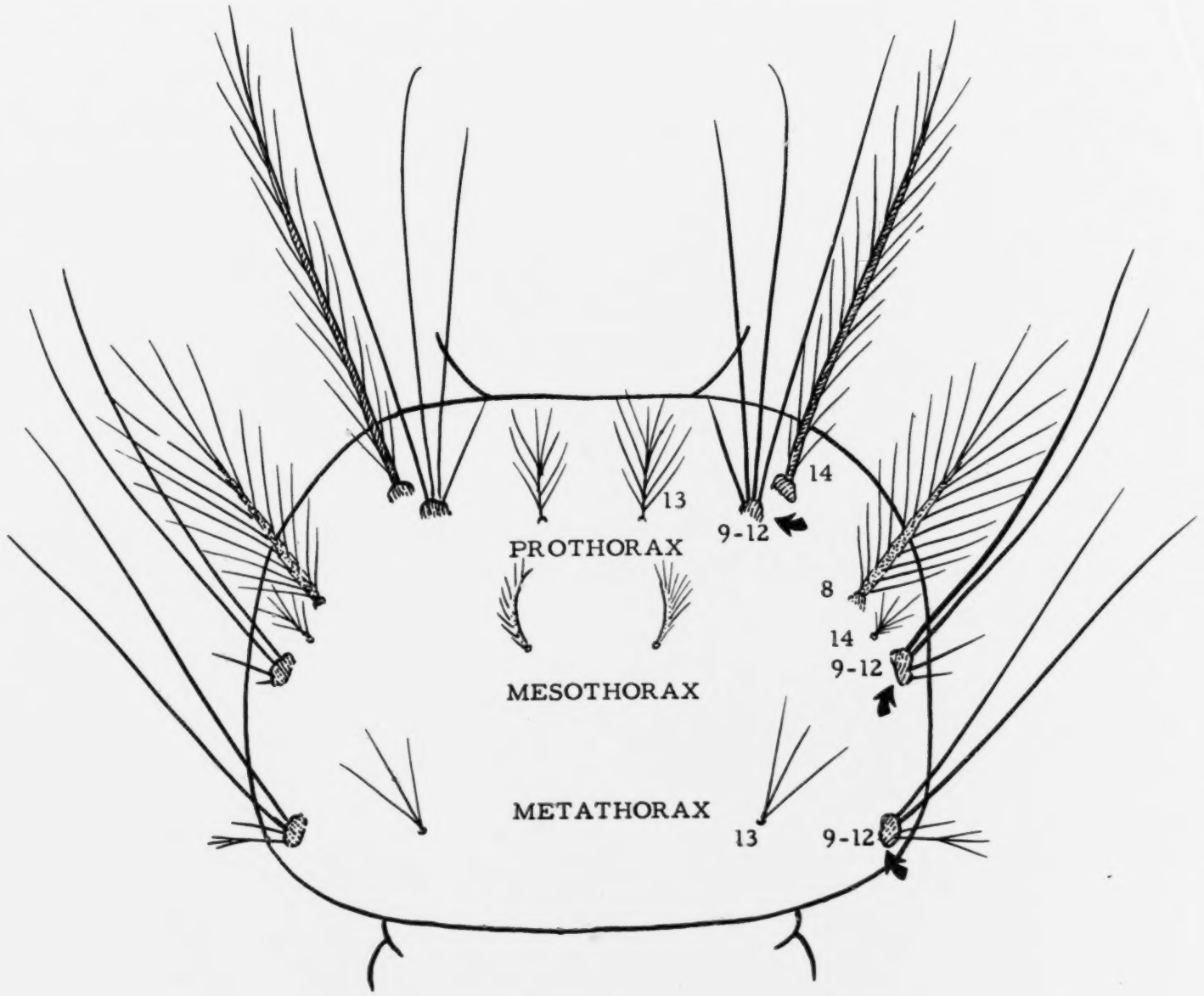
Hair "1" of the prothorax is sometimes called the submedian prothoracic hair. Its size and shape are of great importance in identification of Anopheles larvae as shown below:



A. quadrimaculatus A. darlingi A. albimanus

The pleural hairs are of great significance in separating the groups of Old World Anopheles.

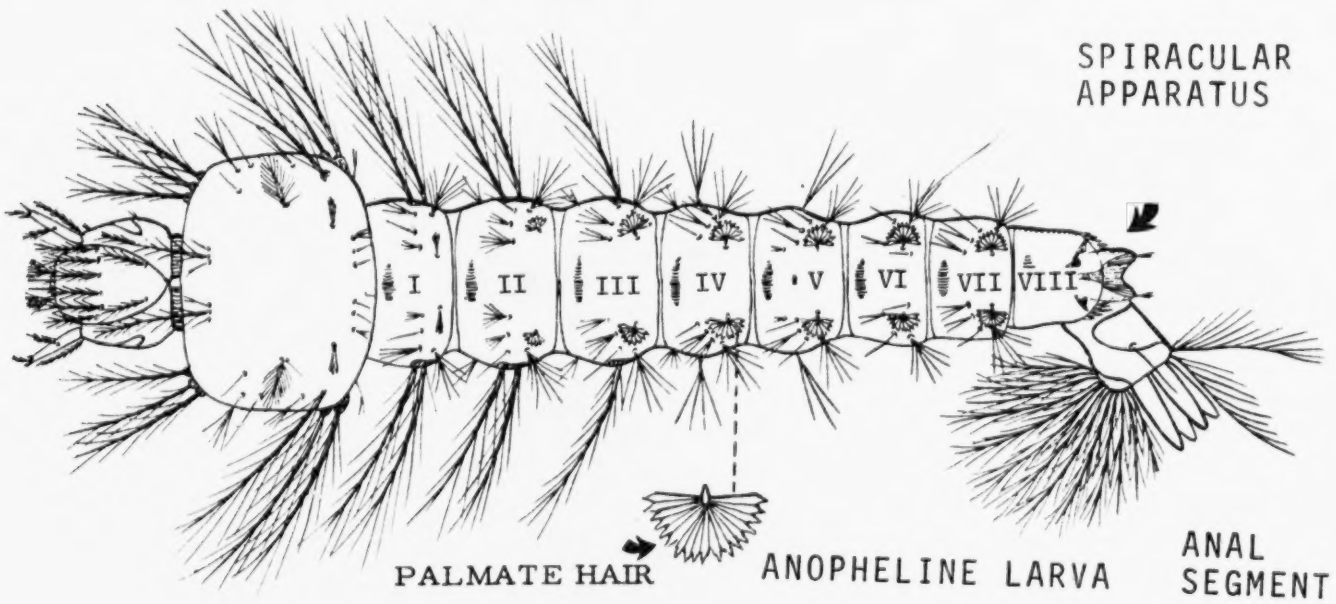
These consist of 3 groups of 4 hairs, Nos. 9-12, of varying sizes and branches arising from a common tubercle. The 3 pleural groups are called the prothoracic group, mesothoracic group, and metathoracic group, after the 3 main parts of the thorax.



PLEURAL HAIRS OF THORAX

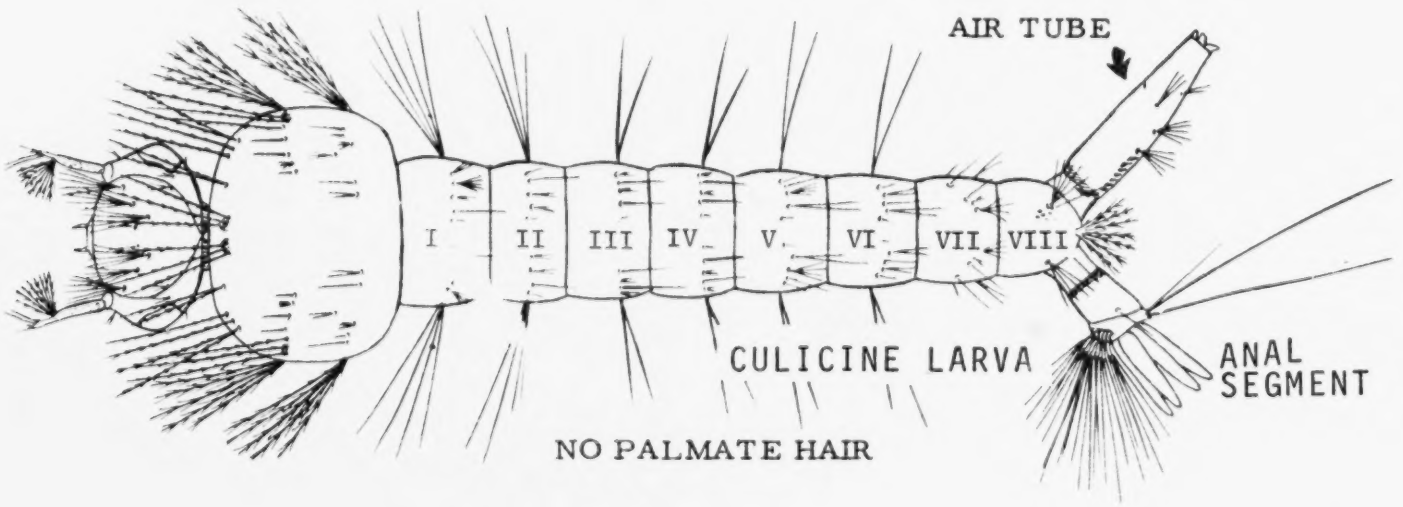
The third body region, the abdomen, is narrower than the thorax and is composed of 10 segments. The first 8 segments are separated from each other by well-defined constrictions. The ninth is represented by an air tube in culicines and a spiracular apparatus in anophelines. The tenth segment is somewhat cylindrical and forms the anal segment surrounding the posterior part of the alimentary canal ending in the anus. It is quite variable but usually bears a lateral or tergal plate, specialized hairs, and 2 or 4 anal gills.

AIR TUBE ABSENT; ABDOMEN WITH PALMATE HAIRS

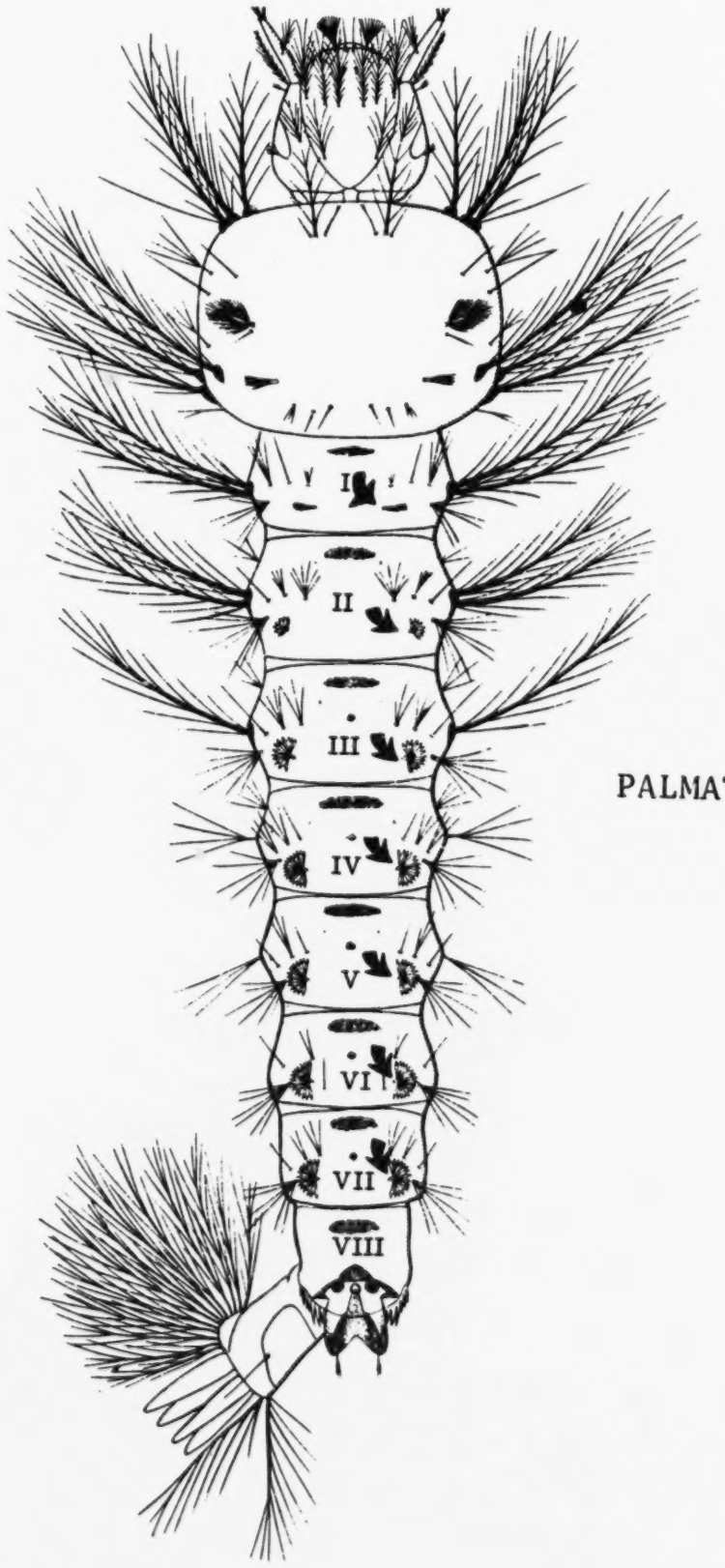


The air tube is a cylindrical structure arising from the eighth abdominal segment. It is present in culicine larvae but absent in anopheline larva.

AIR TUBE PRESENT; ABDOMEN WITHOUT PALMATE HAIRS

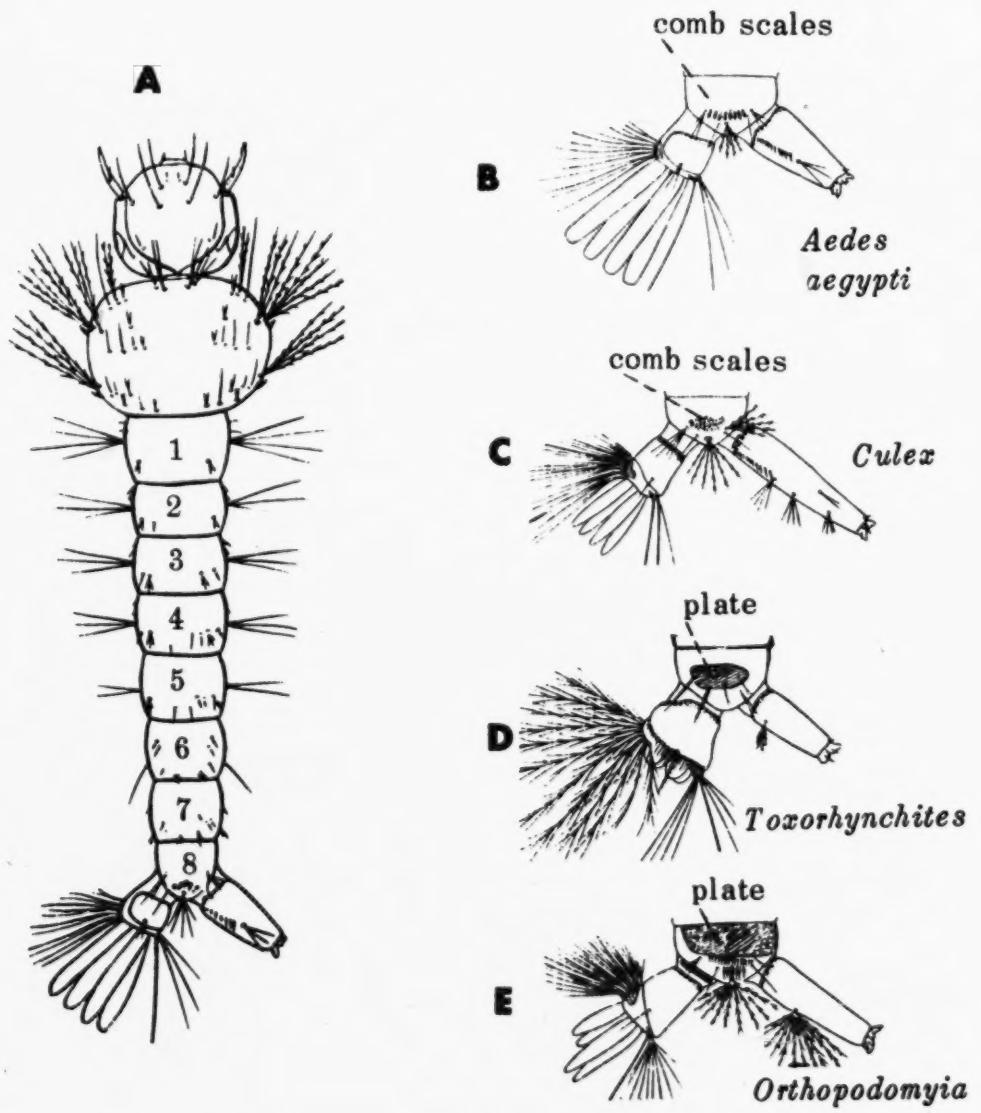


In dorsal view, the palmate hairs are among the most conspicuous structures on the anopheline abdomen. They appear like a pair of palm-like or fan-shaped structures, always well-developed on segments IV and VI and sometimes on segments I to VII. The number of well-developed palmate hairs is a good, easily seen character to use in species identification.

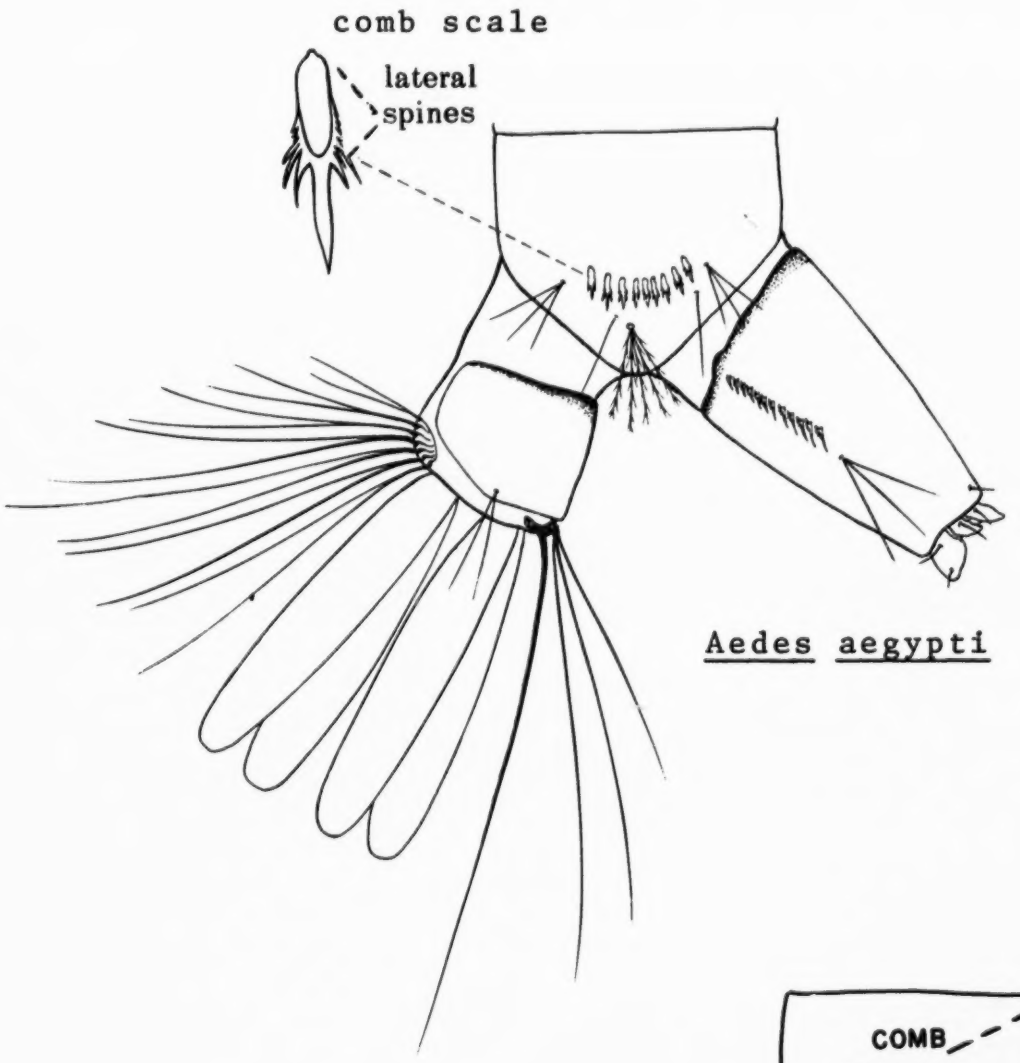


PALMATE HAIRS

In culicines on the eighth abdominal segment (drawings B & C) there are small structures called <u>comb scales</u>, which collectively form a comb. In some species the comb scales are few in number and are arranged in a single line, as in B. In other species the comb scales are more numerous and occur in a patch of two or more rows (C), collectively termed the <u>comb</u>. In some species of mosquitoes, there are lateral plates on the eighth abdominal segment, too (drawings D & E).

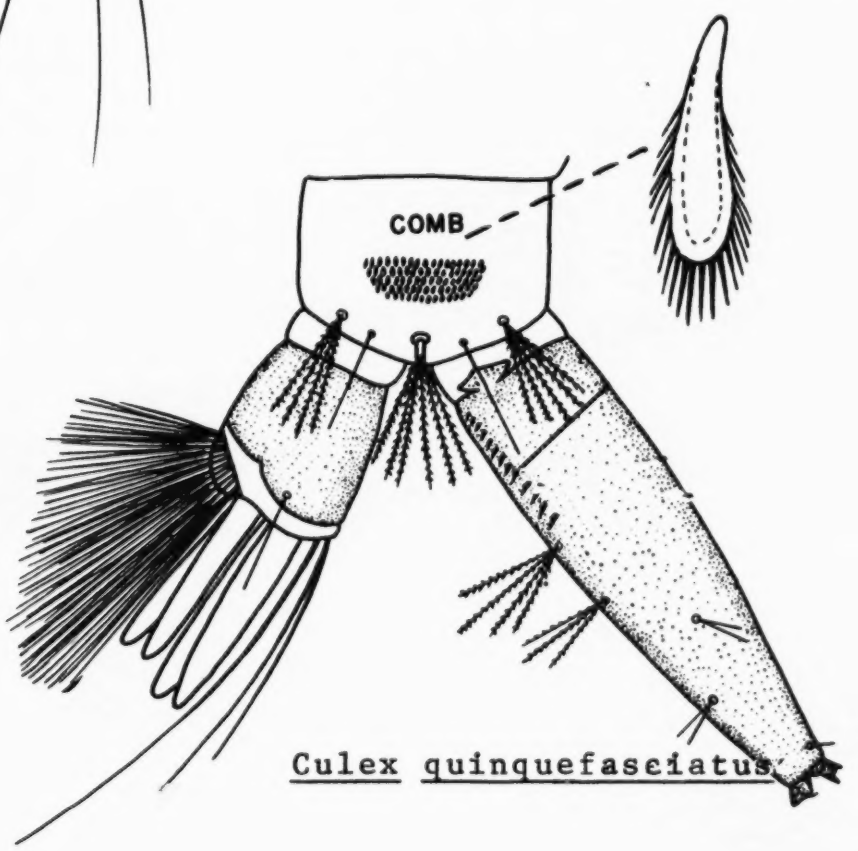


The comb scales are arranged in a single or double row, or a patch, on the eighth segment. The number, arrangement, and shape of the comb scales furnish characters of great importance in species identification.



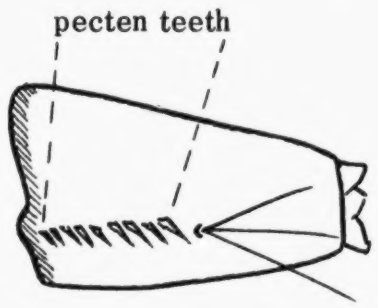
Aedes aegypti

comb scales

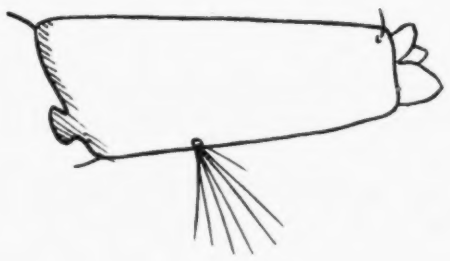


Culex quinquefasciatus

The air tube is a cylindrical structure arising from the eighth abdominal segment. A comb-like row of tiny teeth, called pecten, is present on the air tube of six genera: Aedes, Culex, Deinocerites, Psorophora, Culiseta, and Uranotaenia.

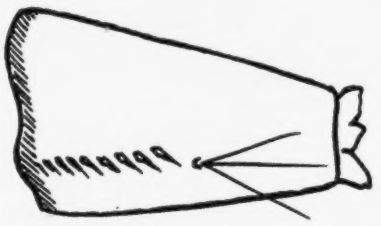


Four genera: Mansonia, Orthopodomyia, Toxorhynchites, and Wyeomyia, do not have pecten teeth on the air tube.

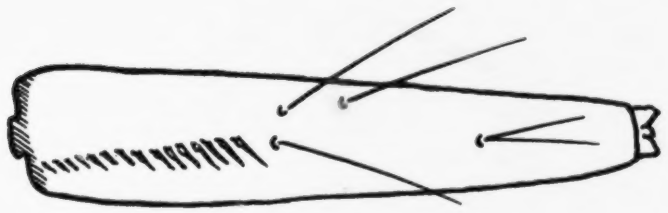


The number and position of single or branched hairs on the air tube is of great importance in identifying mosquito larvae.

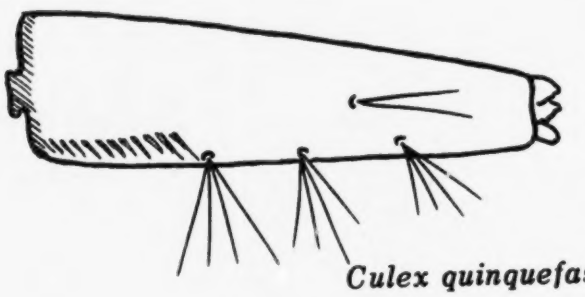
Aedes larvae typically have a single hair, a two-branched hair tuft or one many-branched hair tuft on each side of the air tube. When a hair tuft has two or more branches, all of the branches arise from the same socket.



Aedes aegypti



Culex restuans

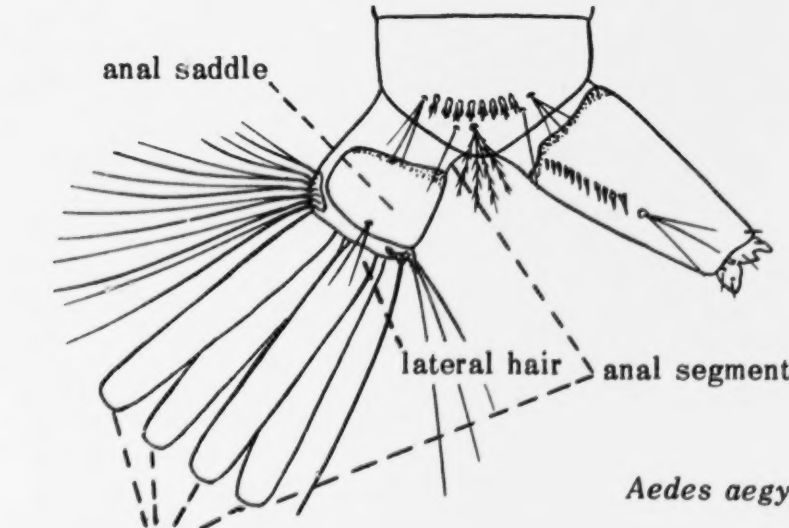


Culex quinquefasciatus

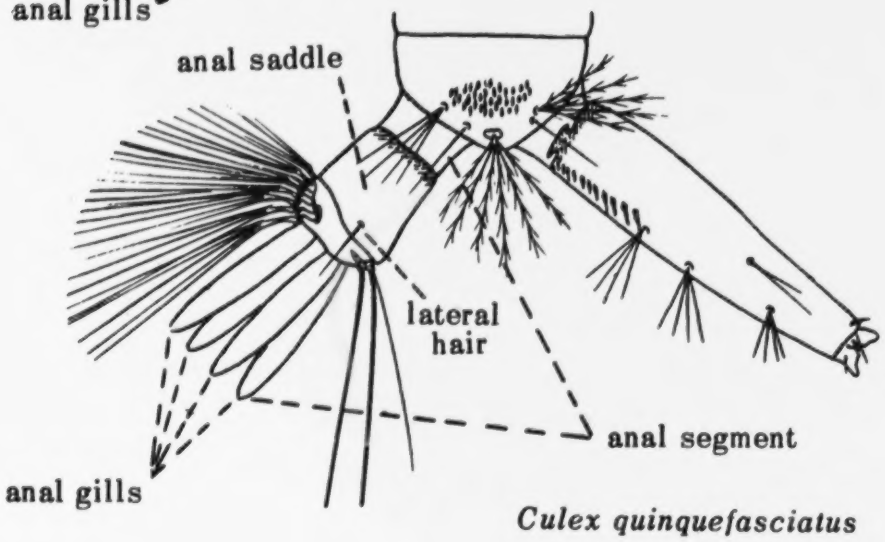
Culex larvae have several hairs, or several two-branched or many-branched hair tufts, on each side of the air tube.

Culiseta has an air tube with a basal hair tuft.

The anal segment arises from the eighth abdominal segment. It bears an anal saddle which partially or completely encircles the anal segment. On the anal saddle there is a lateral hair which may be single, double, or many-branched. The anal segment also bears 2 or 4 anal gills which may be long or short, equal or unequal.

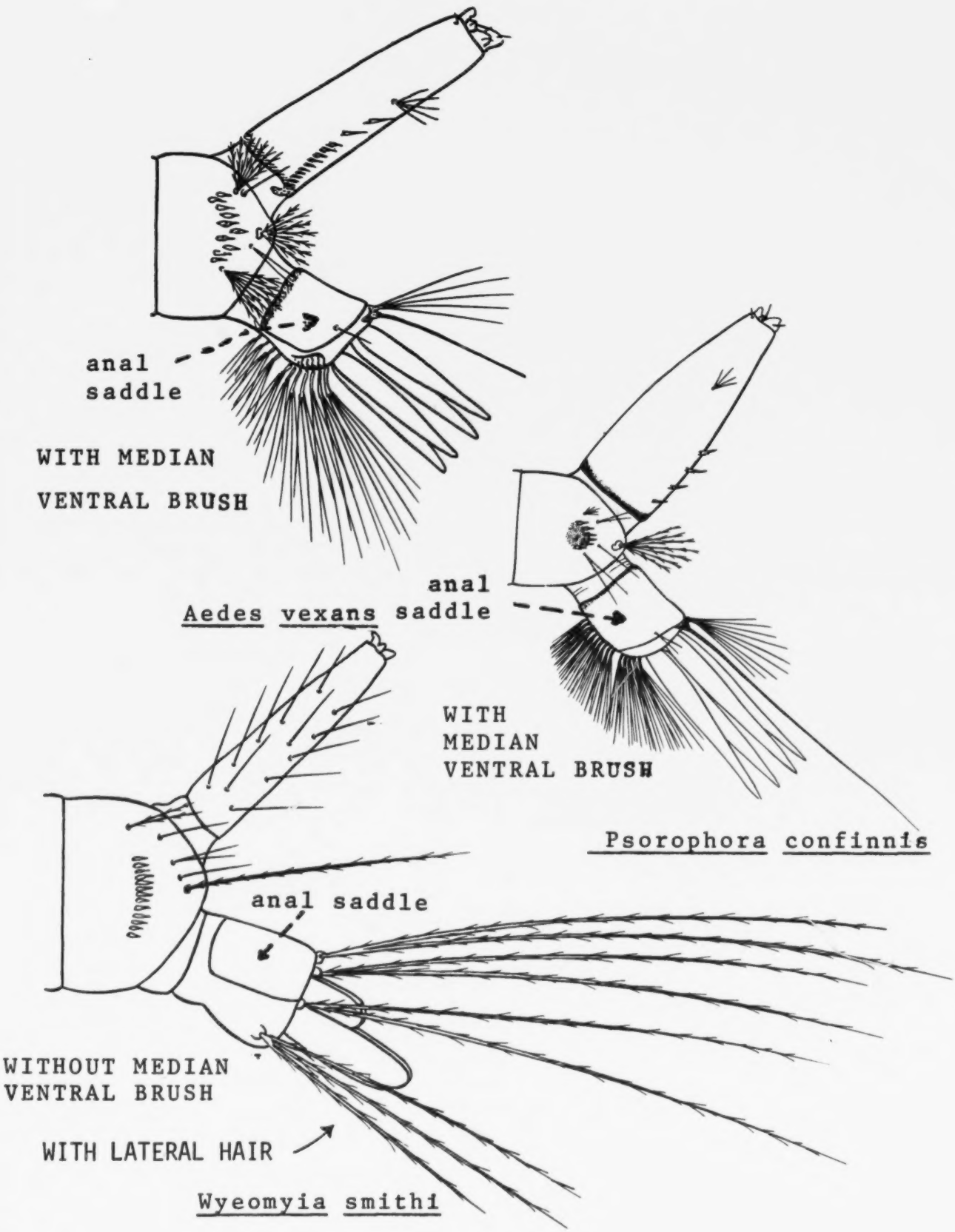


Aedes aegypti



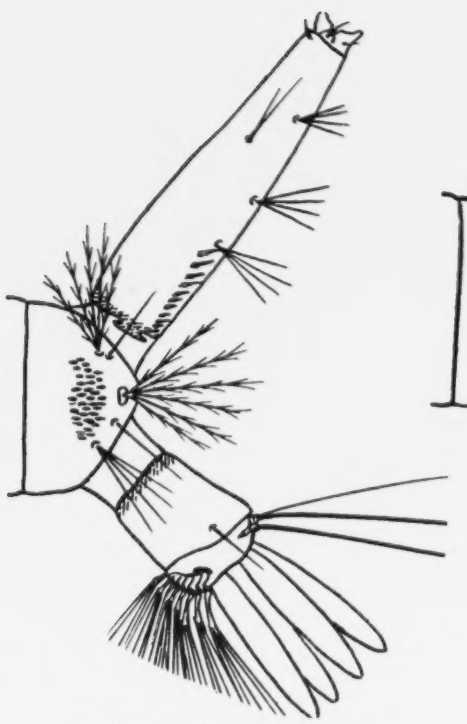
Culex quinquefasciatus

A median ventral brush may be absent or present on the anal segment and it may or may not pierce the anal saddle.

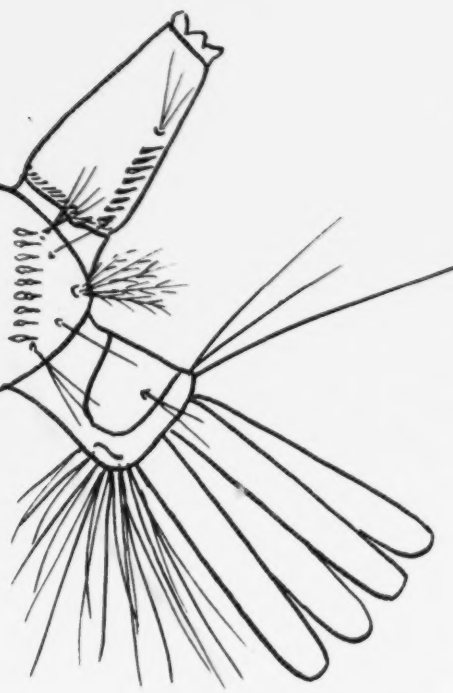


Test Yourself:

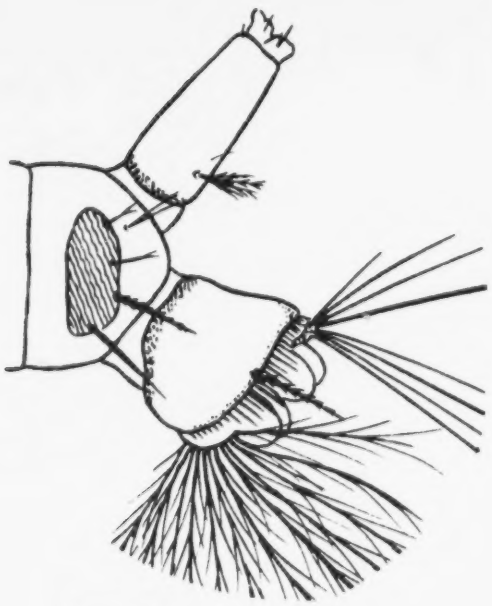
Write in the words comb, pecten, lateral hair, lateral plate, median ventral brush, anal saddle, anal gills, air tube, and hair tuft or hair as they apply on the drawings below:



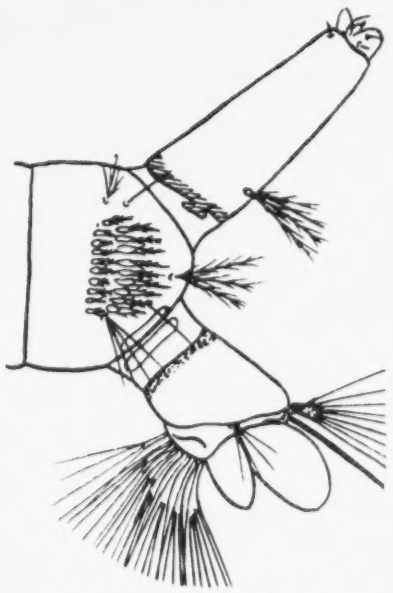
Culex quinquefasciatus



Aedes aegypti



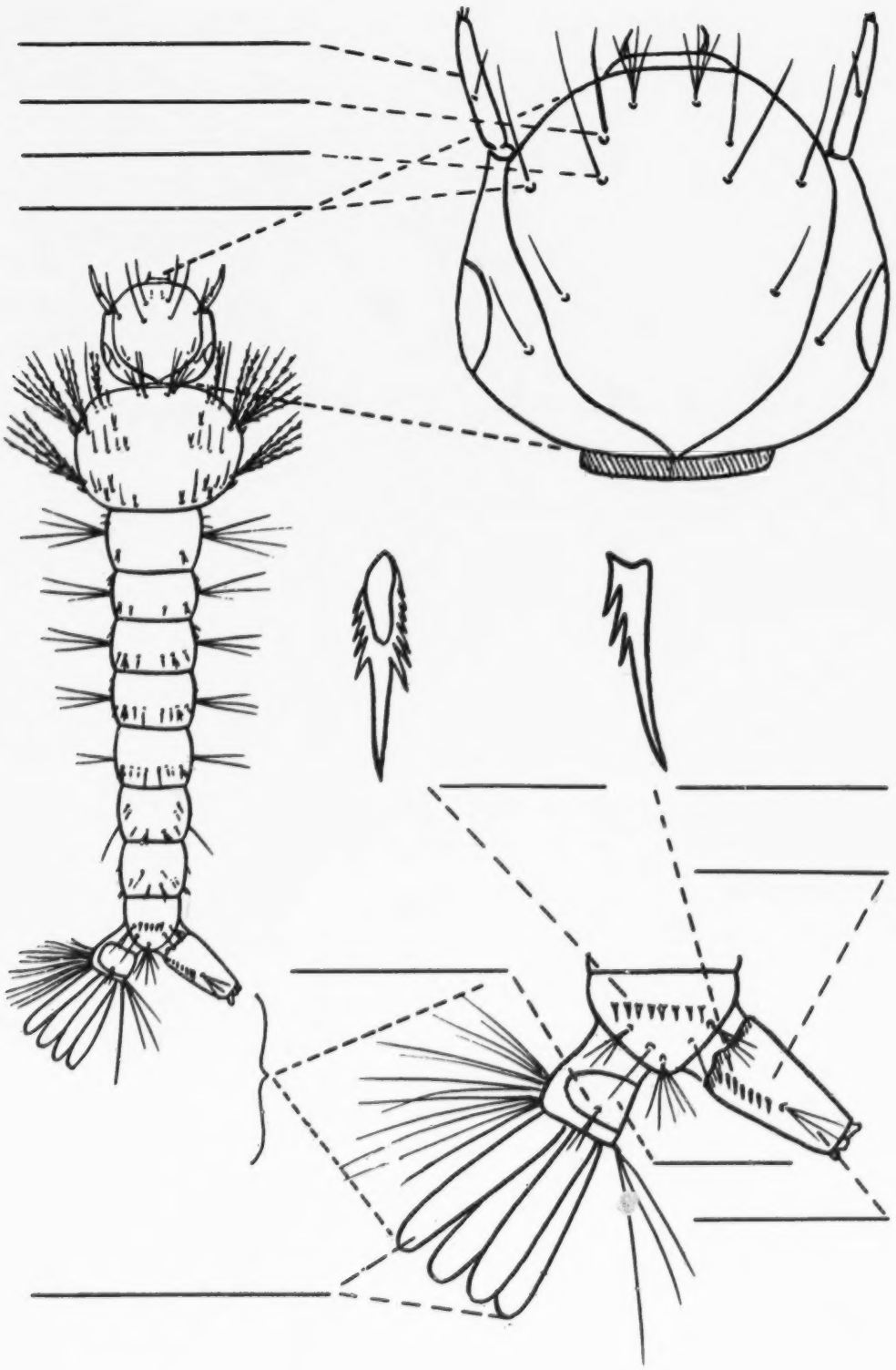
Toxorhynchites rutilus



Orthopodomyia alba

SUMMARY SHEET

Label parts of mosquito larva



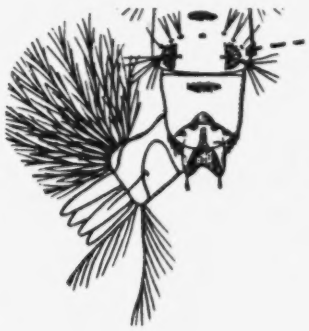
PART III

GENERIC CHARACTERS OF NORTH AMERICAN MOSQUITO LARVAE

The 11 genera of North American larvae have well-defined generic characters which divide them into three groups, as shown on the "Pictorial Key to the U.S. Genera of Mosquito Larvae". Haemagogus, reported from the Brownsville, Texas area, is very similar to Aedes and is not included in this discussion.

THE THREE GROUPS ARE:

GROUP I The anophelines, containing only the genus Anopheles, with palmate hairs and no air tube.



GROUP II The culicines, without palmate hairs, and an air tube with a pecten on the basal part of the air tube.

Culiseta

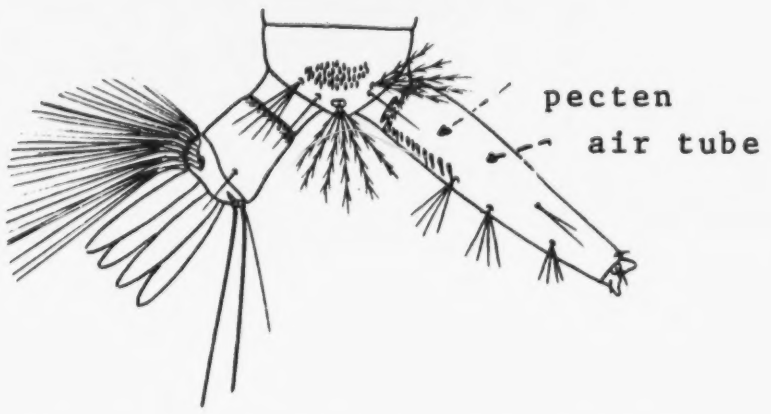
Culex

Deinocerites

Uranotaenia

Aedes

Psorophora



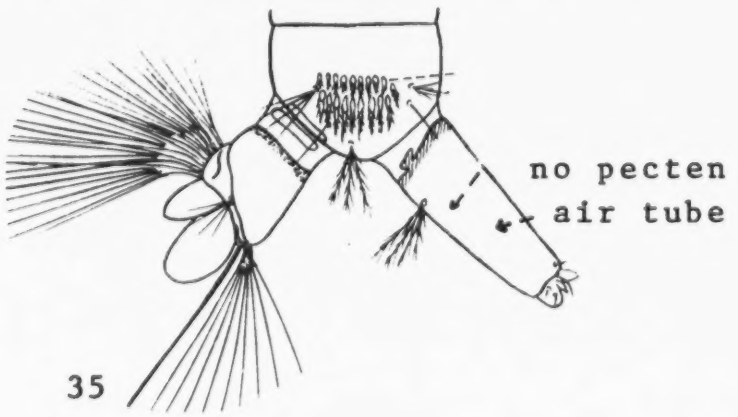
GROUP III The culicines, without palmate hairs, and an air tube without a pecten on the basal part of the air tube.

Mansonia

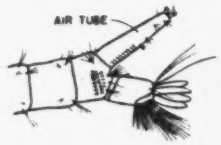
Toxorhynchites

Orthopodomyia

Wyeomyia



PICTORIAL KEY TO U S GENERA OF MOSQUITO LARVAE



Air tube present. Abdomen without palmate hairs.

Air tube absent. Abdomen with palmate hairs on middle segments.

ANOPHELES

Air tube with pecten.

Air tube without pecten.

Air tube with a basal pair of hair tufts. A row of tufts or straight hairs present in some species.

CULISETA

Air tube without a basal pair of hair tufts. Air tube with one to many pairs of tufts or hairs beyond base.

Air tube not pointed; without teeth.

Air tube pointed and with teeth on one side.

MANSONIA

Air tube with several pairs of tufts or hairs.

Head with lateral pouches. Rare species found in south Florida and Texas.

DEINOCERITES

Head without lateral pouches.

CULEX

Air tube with only one pair of tufts or hairs on ventral side.

Eighth abdominal segment with a plate bearing a row of teeth on posterior side. Head longer than wide; the common species with four stout spines.

URANOTAENIA

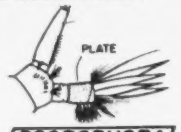
Eighth abdominal segment without a plate. Head wider than long; hairs not spine-like.

Eighth abdominal segment with comb scales. If a lateral plate is present, it does not bear hairs.

Eighth abdominal segment without comb scales, but with lateral plate bearing two spinulose hairs.

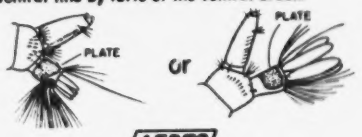
TOXORHYNCHITES (Formerly MEGARHINUS)

Anal segment completely ringed by the plate which is pierced on the midventral line by tufts of the ventral brush.



PSOROPHORA

Anal segment not completely ringed by the plate, or if ringed by the plate, not pierced on the midventral line by tufts of the ventral brush.



AEDES

Anal segment with median ventral brush. Eighth abdominal segment with two rows of comb scales.

ORTHOPODOMYIA

Anal segment without median ventral brush. Eighth abdominal segment with only one row of comb scales.

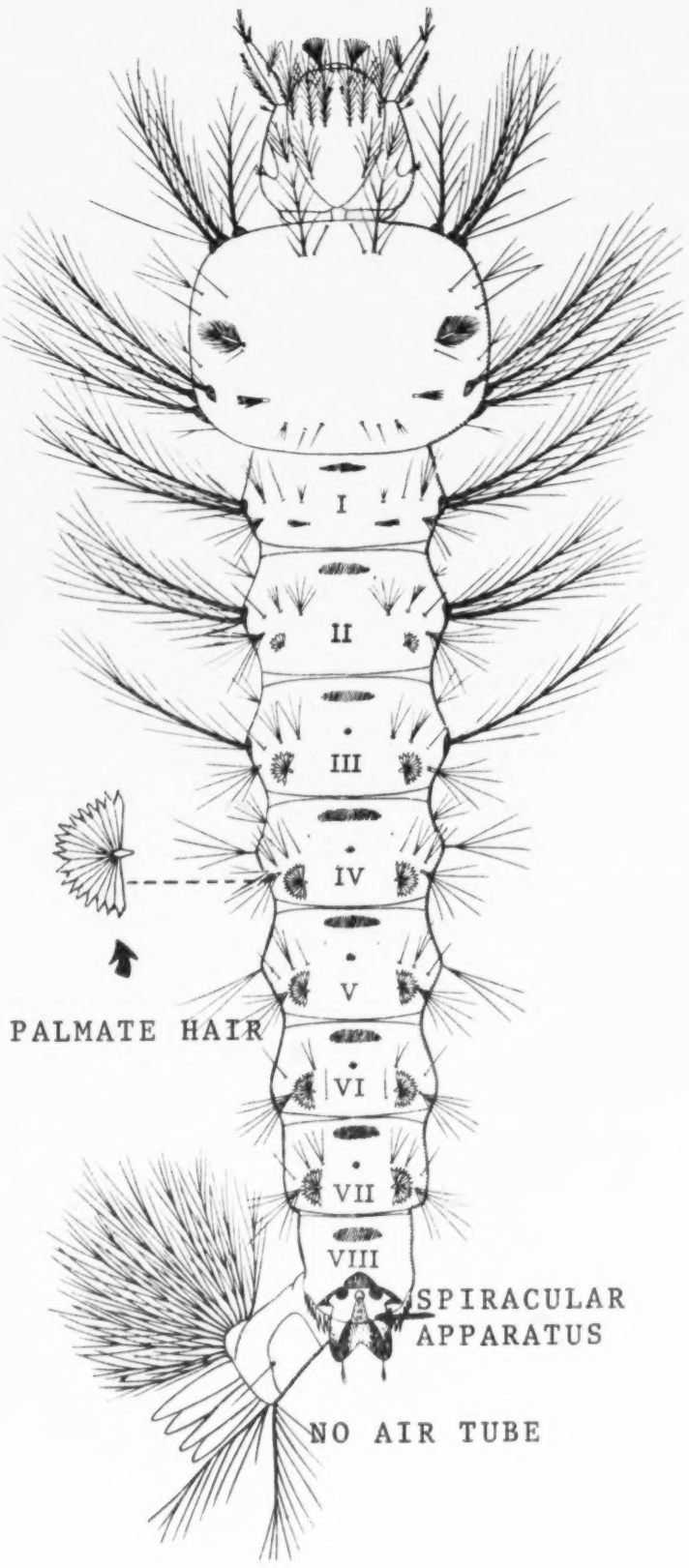
WYEOMYIA

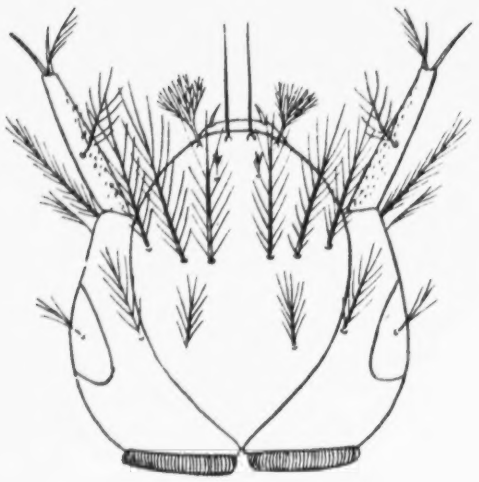
DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
COMMUNICABLE DISEASE CENTER
ATLANTA, GA., SEPT. 1959
PREPARED BY H.D. PRATT

GROUP I

Anopheles can be identified by three characteristics:

1. It has no air tube, only a spiracular apparatus.
2. It has palmate hairs on the middle abdominal segments, in some species on segments I - VII.
3. The head is longer than wide. (In culicine larvae - except Uranotaenia - the head is wider than, or as wide as, long).





HEAD

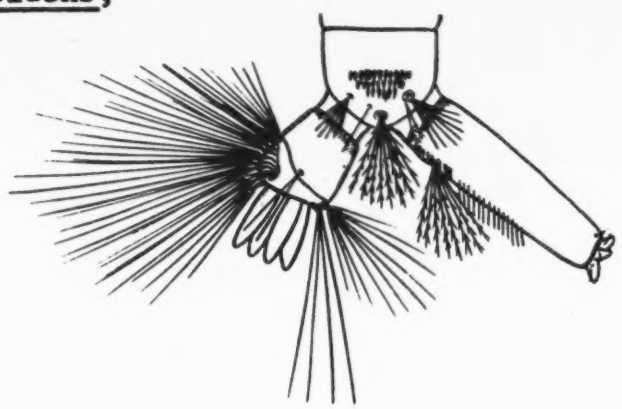
GROUP II

Larvae with a pecten on the basal part of the air tube.

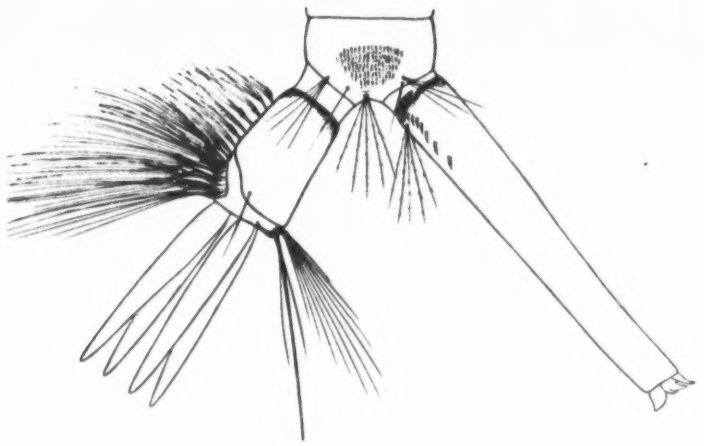
Culiseta always has a hair or hair tuft at the base of the air tube.

There are 3 subgenera Culiseta (Culiseta), Culiseta (Culicella) and Culiseta (Climacura). The subgeneric names are included in parenthesis, example Culiseta (Culiseta). They vary markedly and have air tubes which are characteristically different as described below:

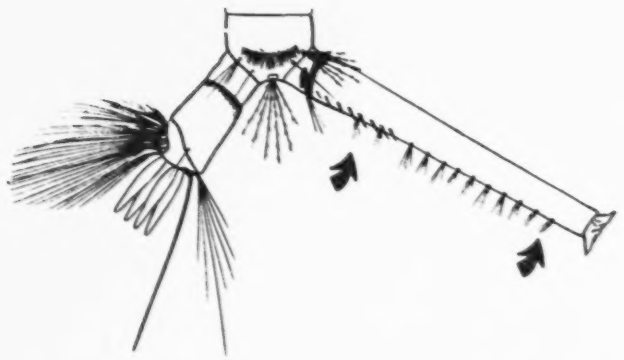
Culiseta (Culiseta) has the apical pecten teeth fine and hair-like, quite different than the broader basal pecten teeth. This subgenus contains 5 North American species: alaskaensis, impatiens, incidens, inornata, and particeps.



Culiseta (Culicella) has only 1 to a few large coarse pecten teeth on the basal part of the air tube. There are 2 common species, minnesotae and morsitans.

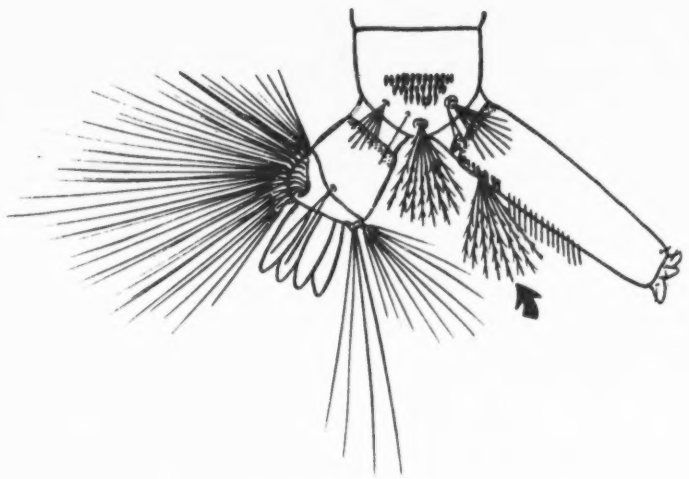


Culiseta (Climacura) has a long slender air tube bearing many hair tufts. It differs in having a basal tuft, often reduced to a single or branched hair. Culiseta melanura is the important species.



Culiseta melanura

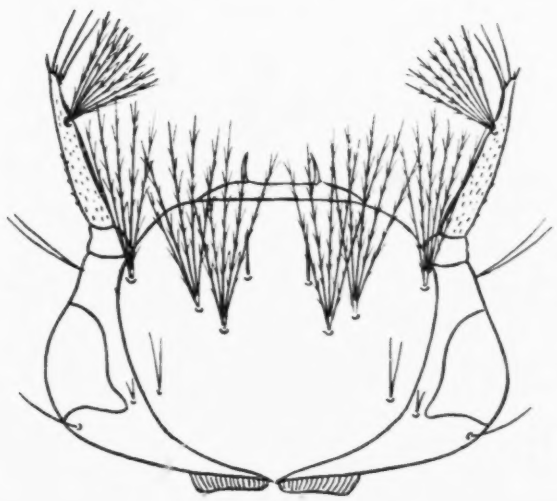
Despite the variations described above, note that species of Culiseta have one characteristic in common - all have a tuft or hair at the base of the air tube.

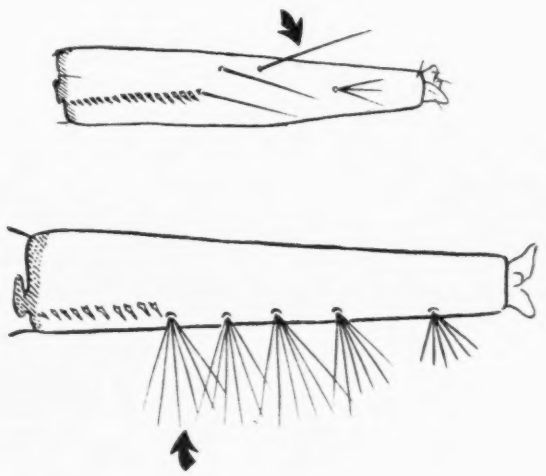


Culiseta inornata

Culex is easily recognized by three characteristics:

1. The pecten on the air tube.
2. Many hairs or hair tufts on the air tube.
3. A normal mosquito head without the triangular, lateral pouch on each side behind the base of the antenna.



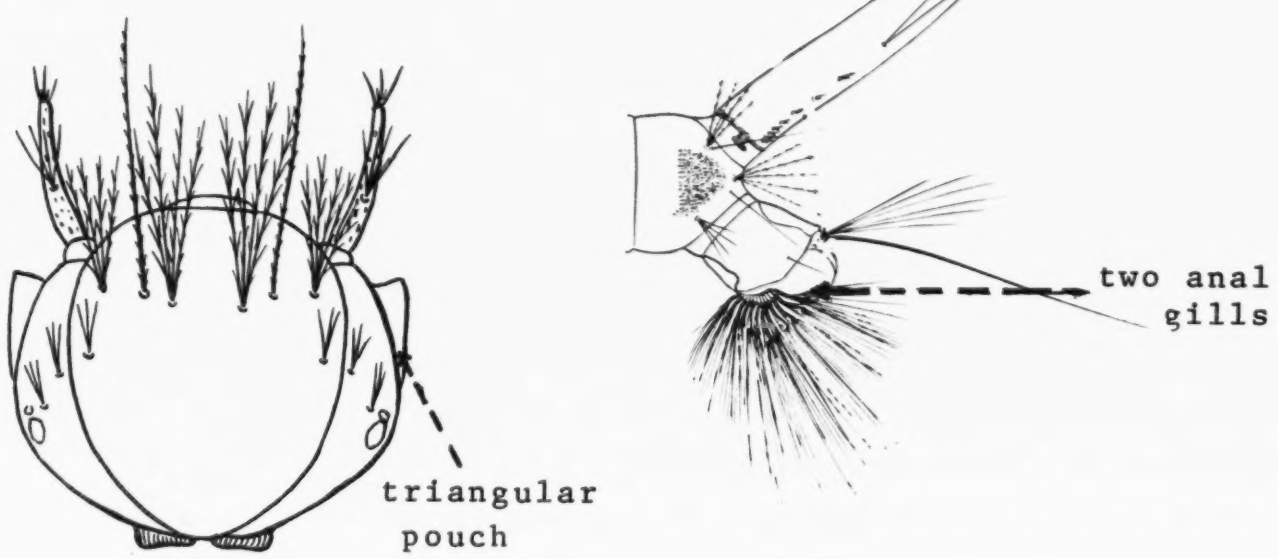


Note: Culex and Deinocerites are the only North American genera with more than one hair tuft, or hairs, on the ventral side of air tube -- that is the side with the pecten. Two rare North American species of Aedes (A. trichurus and bicristatus) have one hair tuft on the ventral side and additional hairs or hair tufts on the dorsal side as well. Culex includes some of the most abundant species throughout United States.

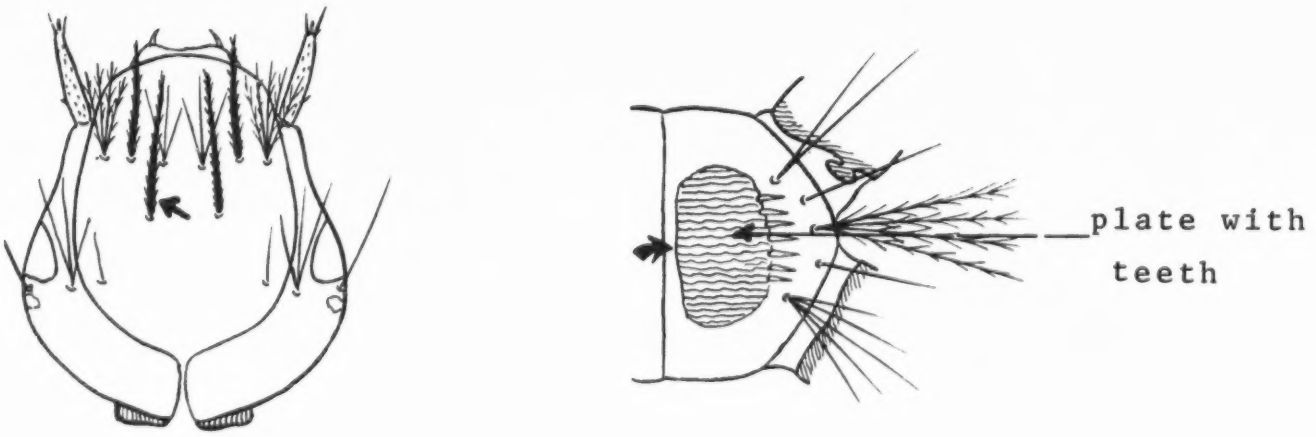
Field workers, particularly in southern and western United States, frequently recognize Culex larvae with the naked eye by the long, slender air tube, 4 to 10 times as long as the basal width. In Northern and Northeastern United States field workers must remember that a few species of Aedes such as A. fitchii and excrucians, and 3 species of Culiseta: morsitans, minnesotae, and melanura have long slender air tubes similar to those of Culex.

Deinocerites differs from other mosquito larvae in having a triangular pouch on each side of the head behind the base of the antenna. The air tube has a hair behind the pecten and one or more hairs (often broken off and not easily visible) on the posterior half. The three North American species are found only in southern Florida and Texas.

The common Florida species, D. cancer, has small, poorly developed plates on the dorsal and ventral sides on the anal segment and only two anal gills.



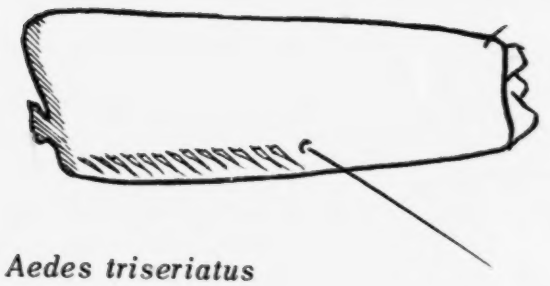
Uranotaenia differs from other North American mosquitoes in having a plate on the eighth abdominal segment with teeth on the posterior margin. The head is noticeably longer than wide. The 2 common species in eastern North America, U. sapphirina and U. lowii, have 4 conspicuous spines on the head.



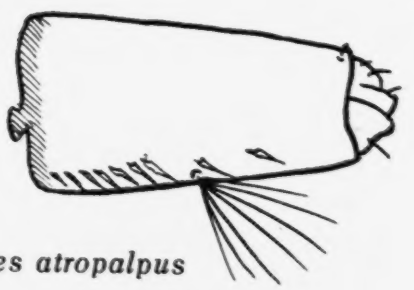
Head hairs stout and spinous

Aedes is recognized by a combination of characters:

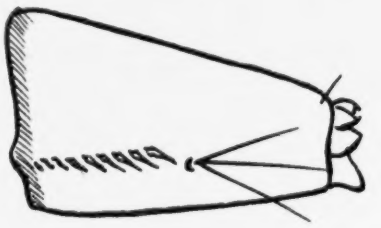
1. The air tube has a pecten.
2. There is only one ventral hair or hair tuft on each side of the air tube. Aedes bicristatus and Ae. trichurus have additional hair tufts on the dorsal side as well as the hair or tuft on the ventral side.
3. The anal segment of the fourth stage larvae is of two types: (a) The anal segment is not completely encircled by a plate (as in Aedes aegypti, Ae. triseriatus, Ae. dorsalis, and Ae. vexans), or (b) The anal segment is completely encircled by a plate, but the median ventral brush lies entirely behind the plate (as in Aedes sollicitans, Ae. taeniorhynchus, and Ae. nigromaculis).



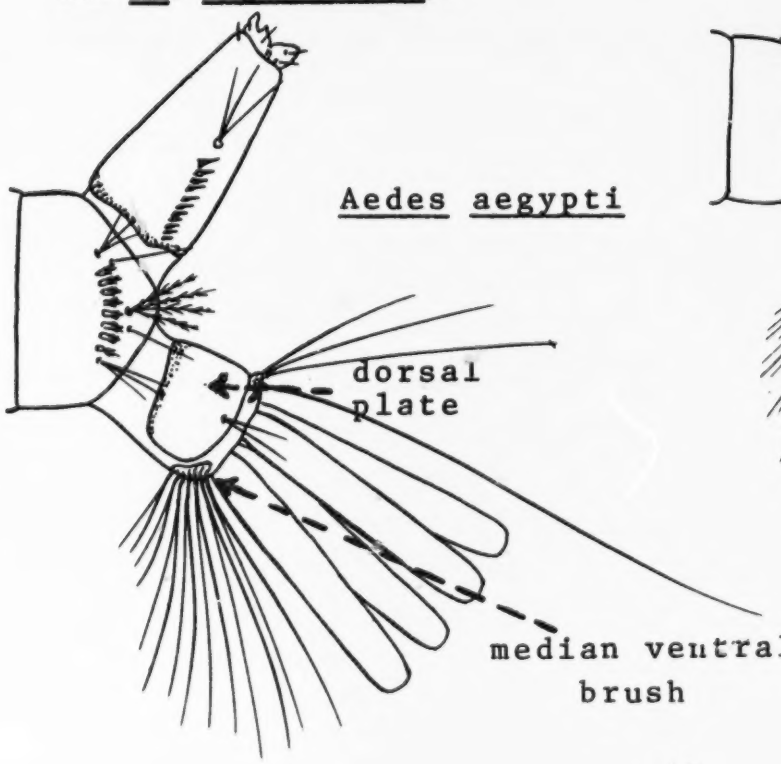
Aedes triseriatus



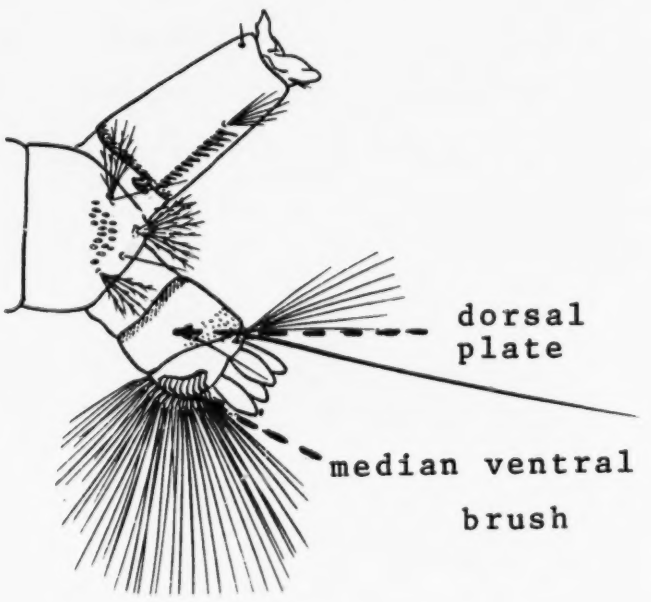
Aedes atropalpus



Aedes aegypti



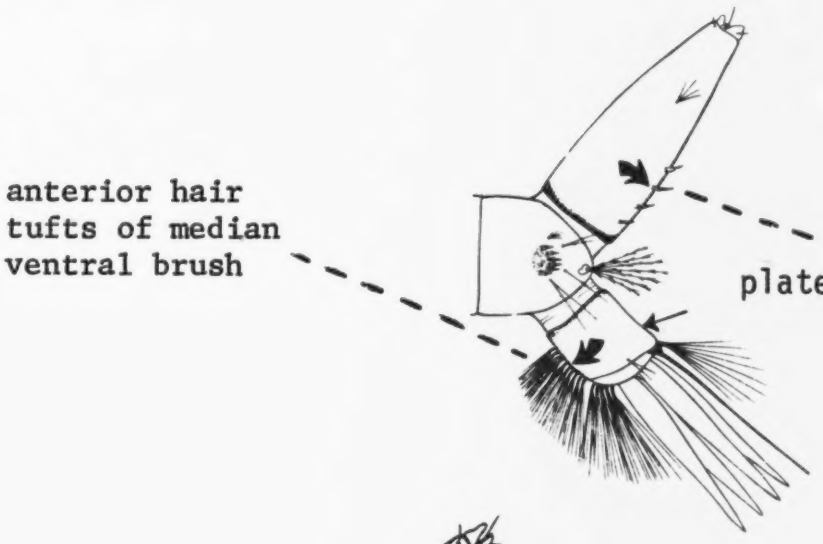
Aedes aegypti



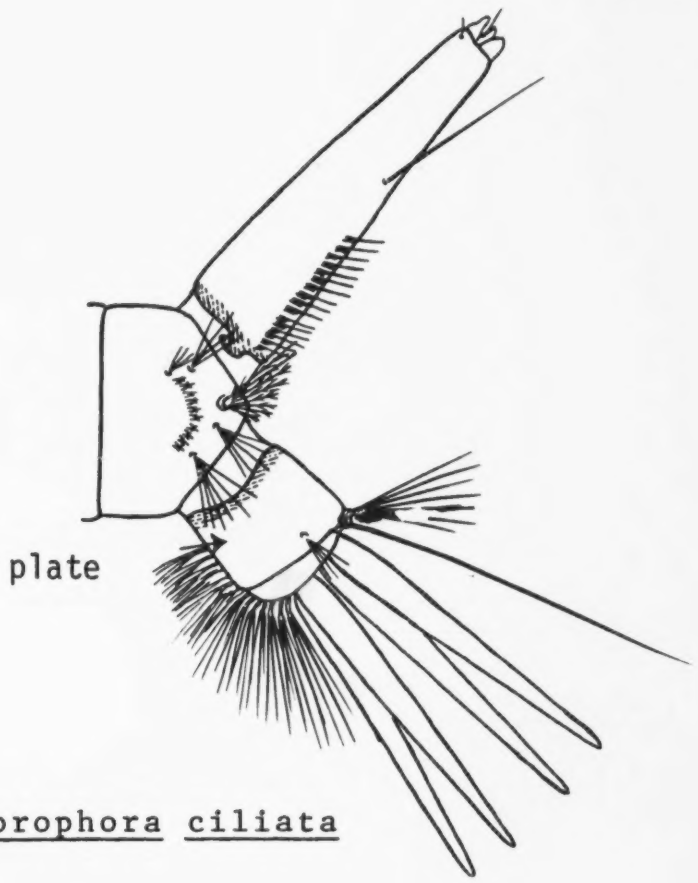
Aedes taeniorhynchus

Psorophora is distinguished by a combination of characteristics:

1. The air tube has a pecten, varying from many teeth to only 2 to 6 teeth, in some species.
2. There is a single hair or hair tuft on each side of the air tube, in some species so small and inconspicuous that it appears absent.
3. The anal segment is completely encircled by a plate which is pierced by some of anterior hair tufts of the median ventral brush.



Psorophora confinnis

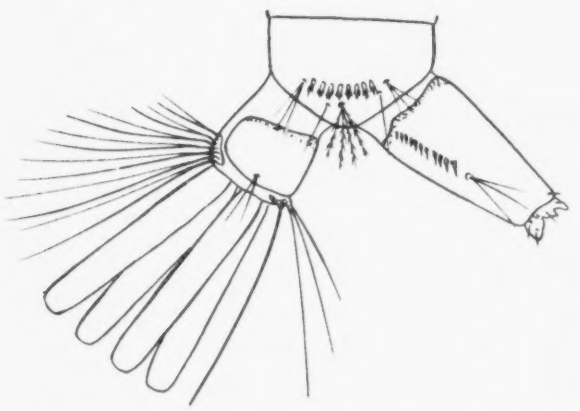


Psorophora ciliata

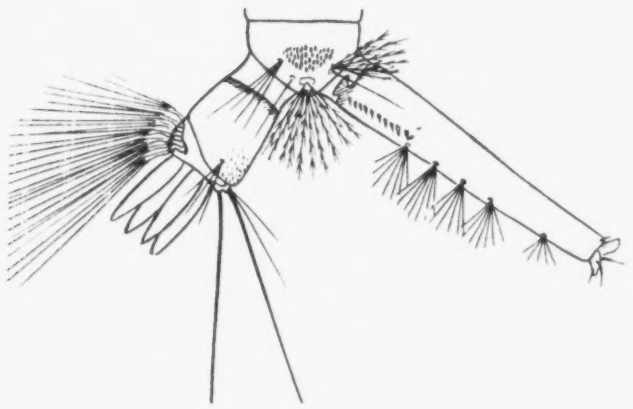
TEST YOURSELF:

Write the genus name below each of the mosquitoes illustrated.

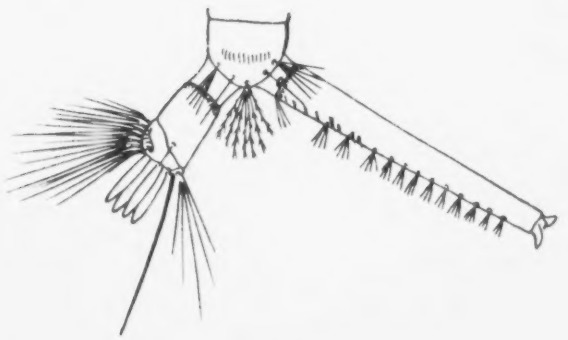
1. _____



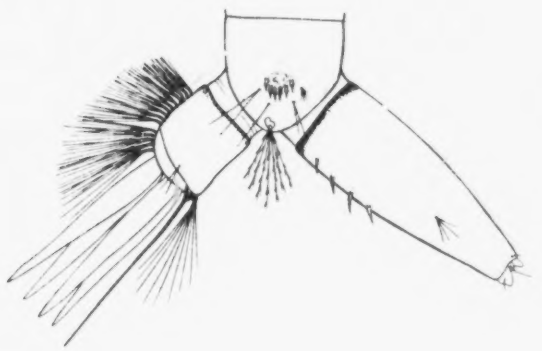
2. _____



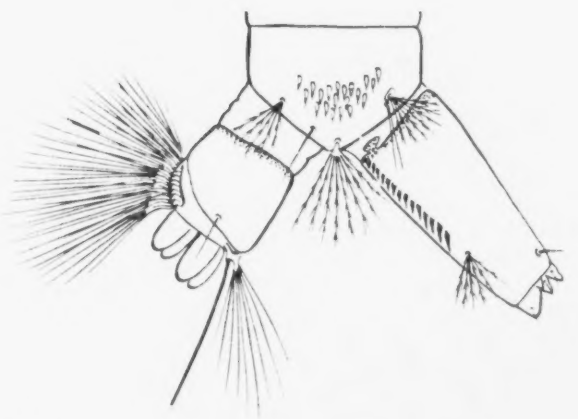
3. _____



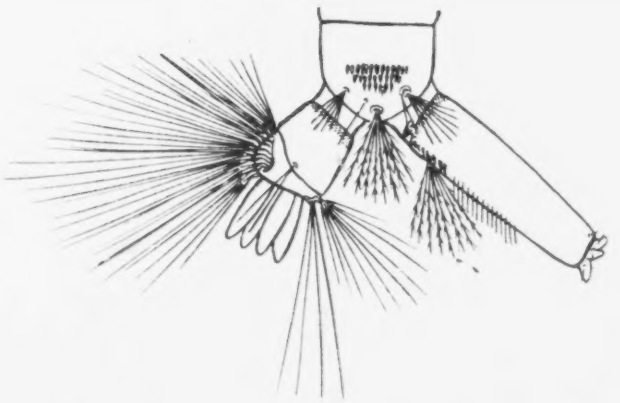
4. _____



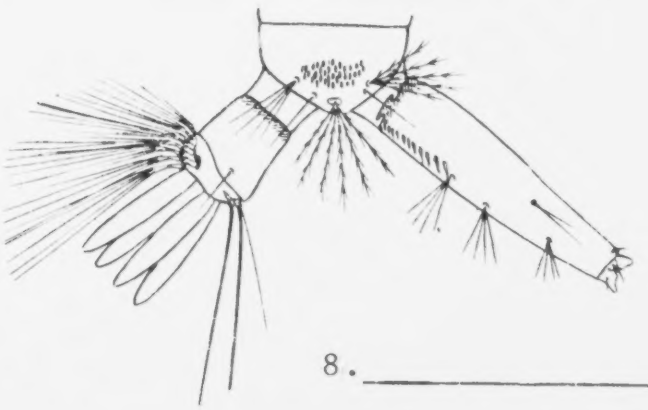
5. _____



6. _____



7. _____



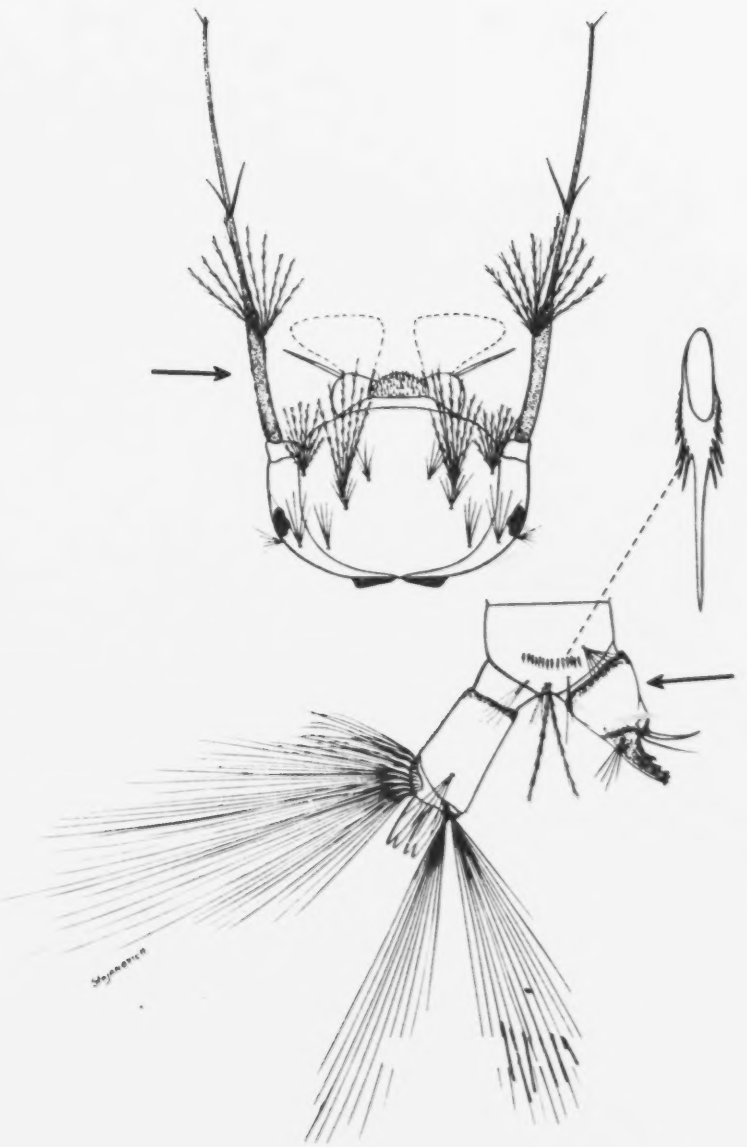
8. _____

Answers on page 78.

GROUP III

Larvae without a pecten on the air tube

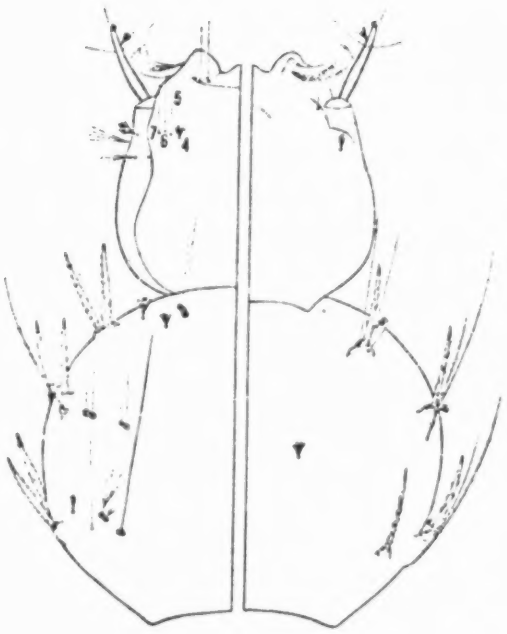
Mansonia is easily recognized by the tapered air tube with teeth on one side toward the tip. The antenna also has a distinctive shape, the terminal part of shaft being markedly more slender than the basal part.



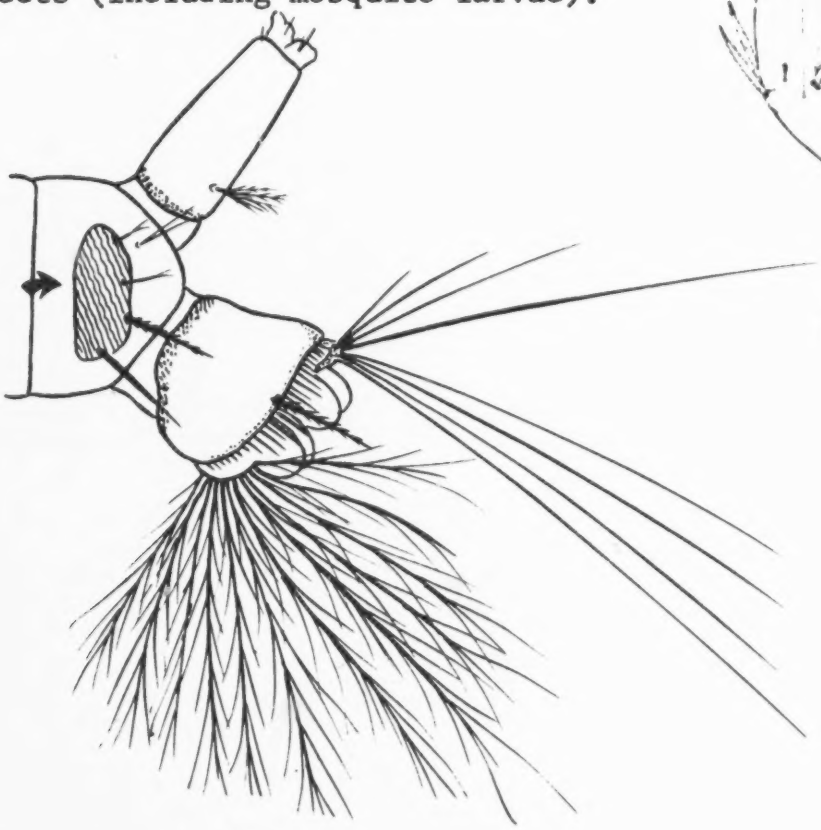
In the field, Mansonia larvae are found with the tapered air tube piercing the roots of aquatic plants, such as water lettuce or cattail.

<u>Toxorhynchites</u> differs from other mosquito larvae as follows:

1. It has no comb scales on the eighth abdominal segment.
2. It has a plate on the eighth abdominal segment bearing 2 spines and 2 hairs.
3. The head is somewhat rectangular and the mouth brushes are modified for grasping and eating other aquatic insects (including mosquito larvae).



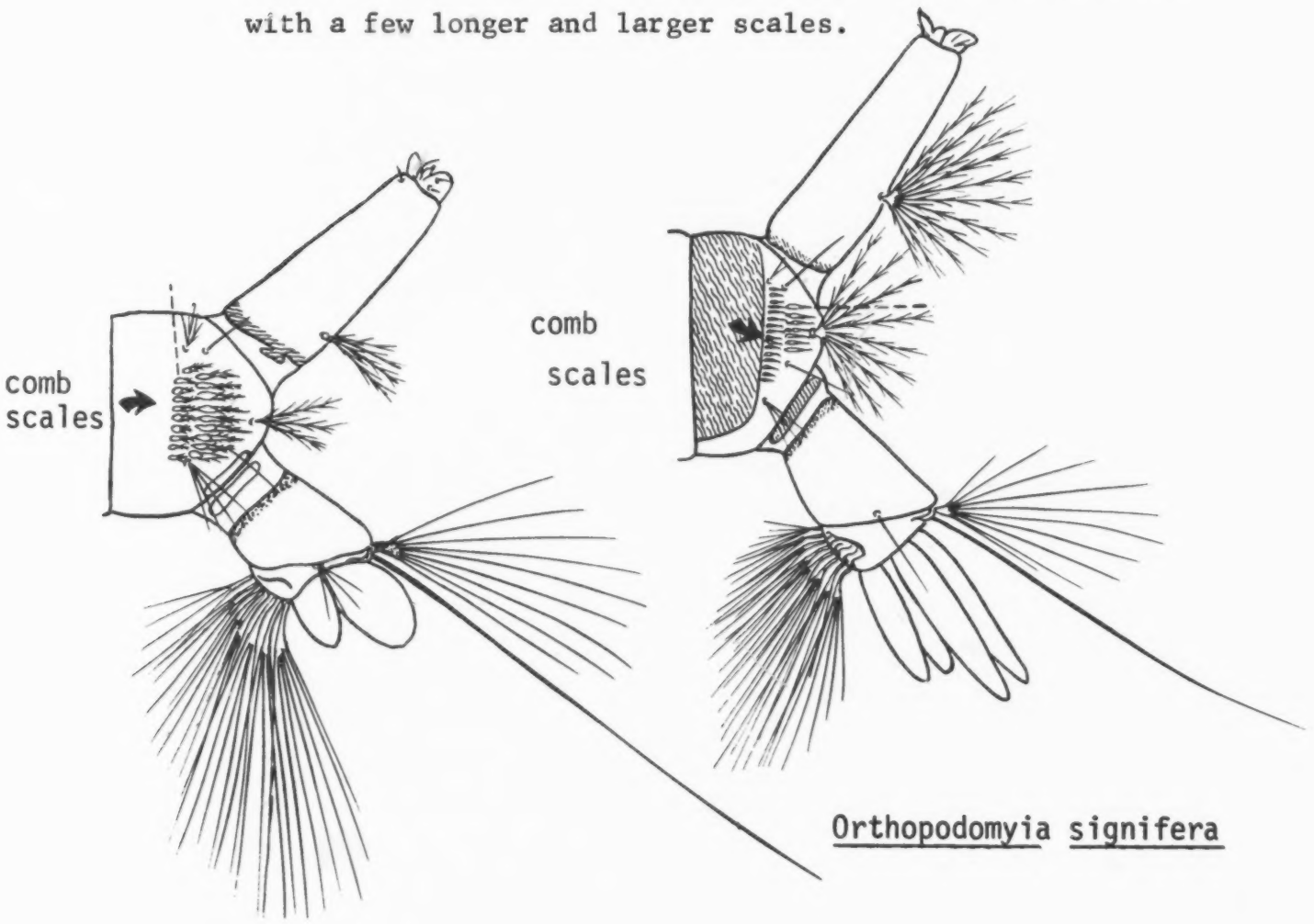
head and thorax
(dorsal and ventral)



Full-grown <u>Toxorhynchites</u> larvae can be recognized with the naked eye because they are noticeably larger than other mosquito larvae occurring in water-holding containers such as tree holes, tires, tin cans, and bottles, or bromeliads. They are brownish colored and have a coarse appearance due to the many spine-like hairs which arise from the hardened tubercles on the thorax and abdomen.

Orthopodomyia is easily recognized by two characteristics:

1. The air tube has no pecten.
2. The eighth abdominal segment bears 2 rows of comb scales: an anterior row with many small scales, and a posterior row with a few longer and larger scales.



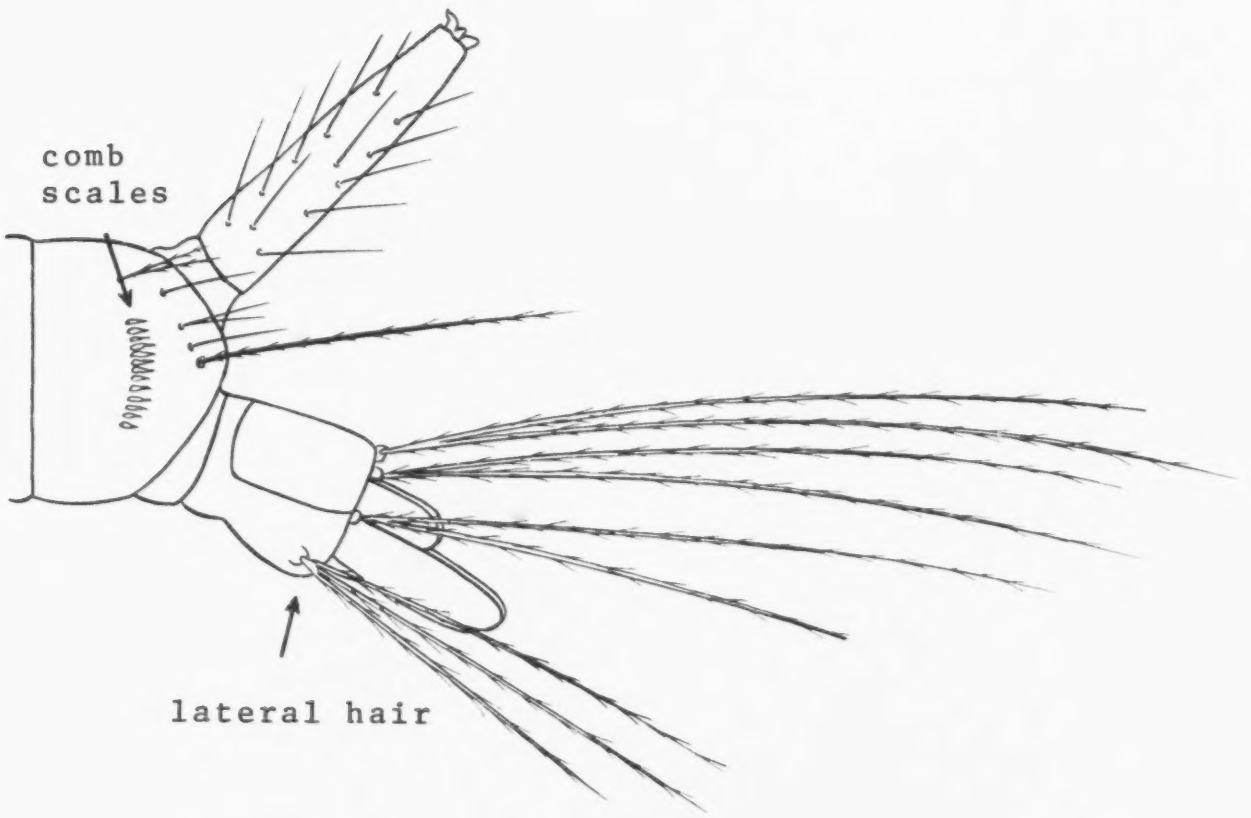
Orthopodomyia alba

Orthopodomyia signifera

The commonest species, O. signifera of eastern United States, has a plate on eighth abdominal segment, and sometimes also on the sixth and seventh segments. Live larvae of this species are easily recognized in the field by the pinkish color of the thorax and abdomen which contrasts with the dark head and tip of body (eighth segment with dark plate and dark air tube).

Wyeomyia has three well-defined characteristics:

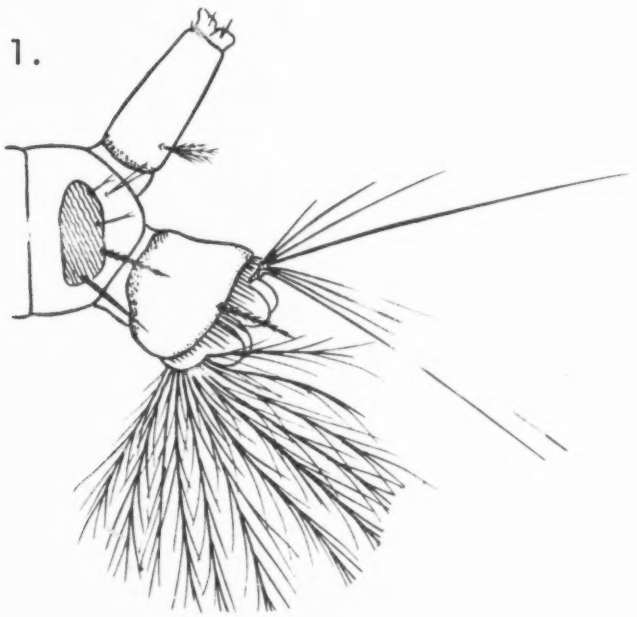
1. An air tube without a pecten, but with many hairs or hair tufts.
2. Only one row of comb scales on the eighth abdominal segment in North American species.
3. An anal segment without a ventral brush, only a lateral hair on each side arising from a definite socket.



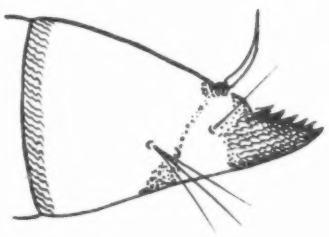
Note: Wyeomyia larvae occur only in water-holding plants. Two species are found primarily in bromeliads in Florida. Two other species (W. smithii and W. haynei) are found in pitcher plants (Sarracenia).

TEST YOURSELF: Identify the larvae illustrated below. Write the generic name beneath each larva and indicate by arrows and short phrases, such as "one row of comb scales," the important identifying generic characters of the 4 genera illustrated below.

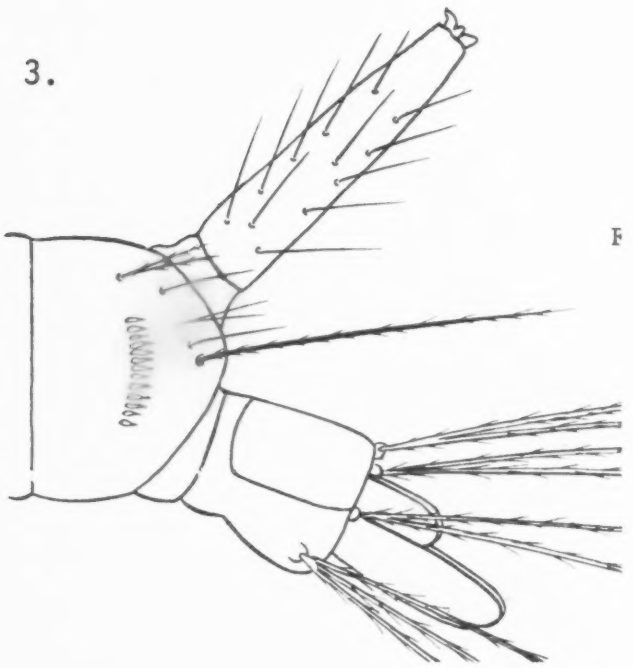
1.



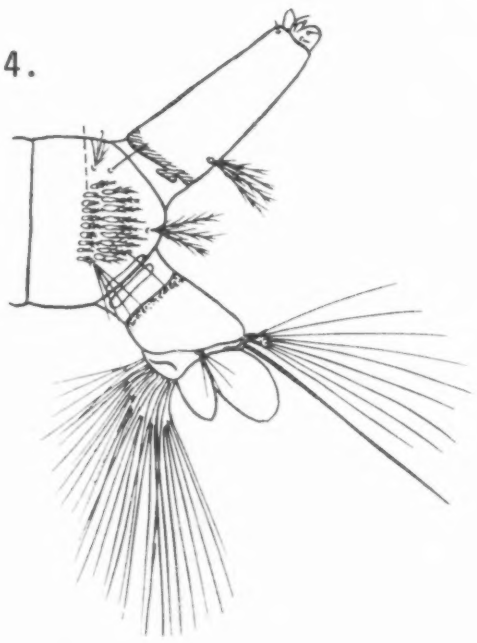
2.



3.



4.



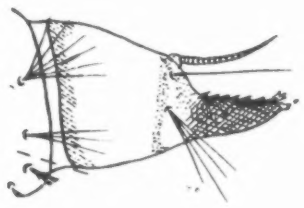
Answers on page 78.

PART IV QUIZ

TEST YOURSELF: For each of the statements below, write the generic name in the appropriate blank.

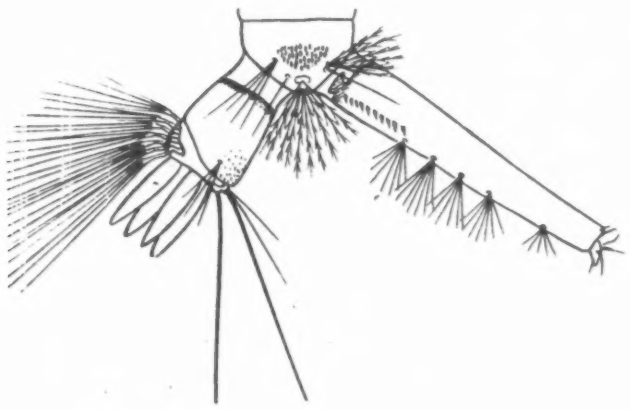
EXAMPLE: The abdomen has palmate hairs and lacks an air tube ANOPHELES

1. The air tube is strongly tapered, lacks a pecten and has teeth on one side towards the tip.



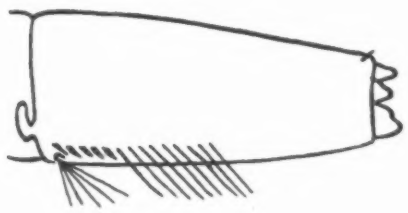
_____

2. The air tube has a pecten and several tufts on the ventral side.



_____

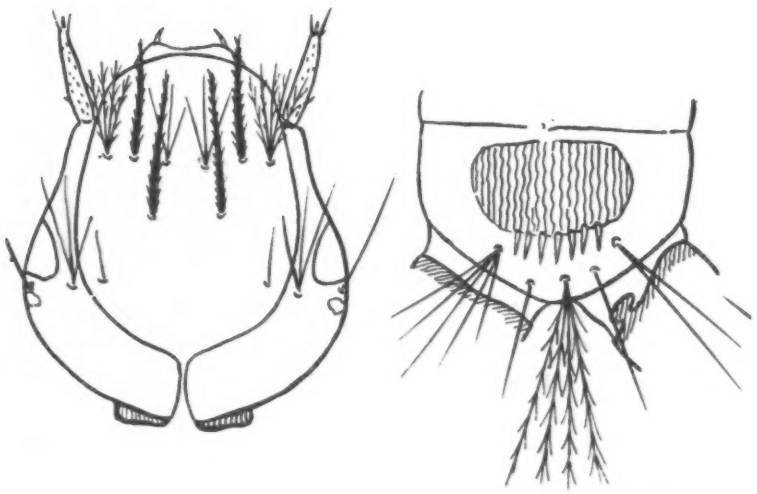
3. The air tube has tuft of hairs near the base and the pecten has coarse basal teeth and fine hair-like outer teeth.



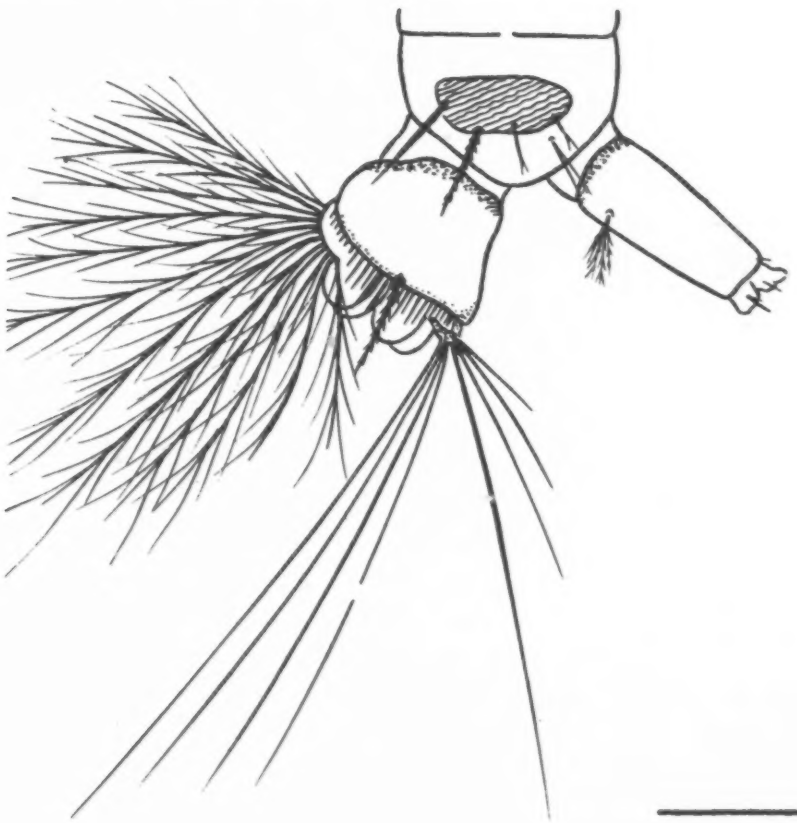
_____

Answers on page 78.

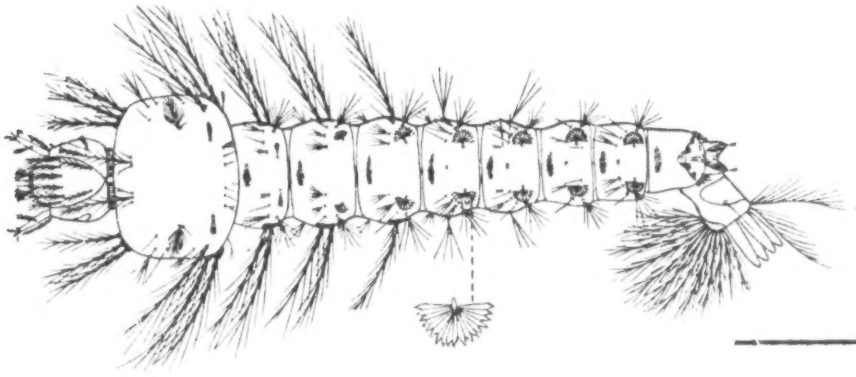
4. The eighth abdominal segment has a plate with teeth on the posterior margin. The head is longer than wide.



5. The eighth abdominal segment has a plate bearing two fine hairs and two coarse spines.

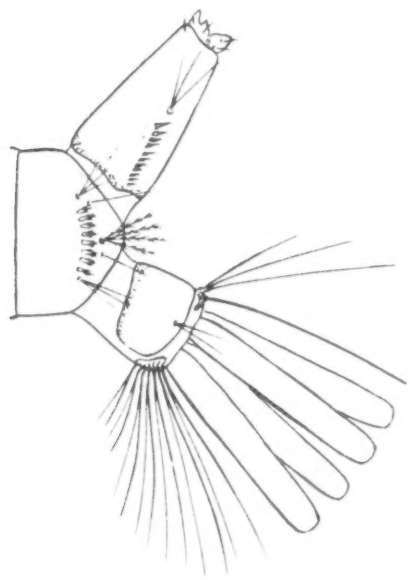


6. The abdomen bears palmate hairs. It has no air tube, only a spiracular plate.



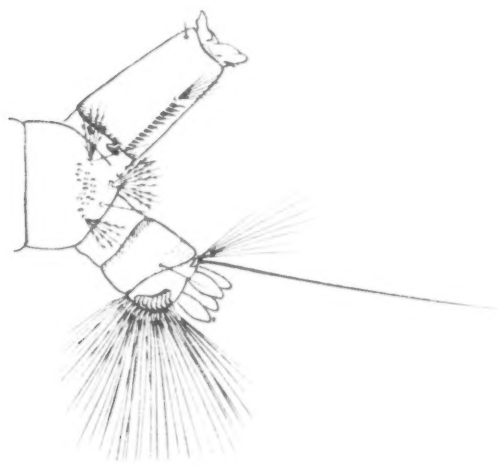
_____

7. The air tube has a pecten and a single hair tuft on each side. The anal segment is incompletely encircled by a plate.



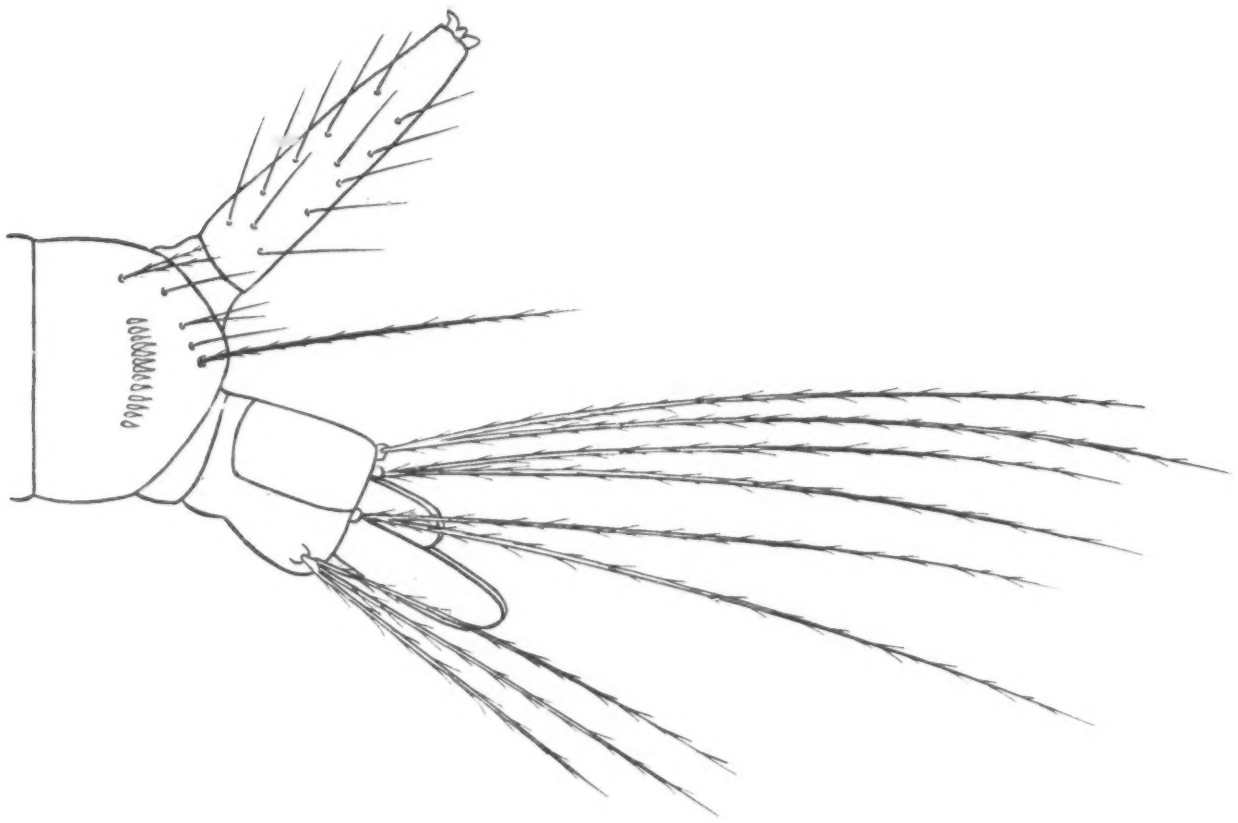
_____

8. The air tube has a pecten and single hair tuft on each side. The anal segment is completely encircled by a plate but the median ventral brush is entirely behind this plate.



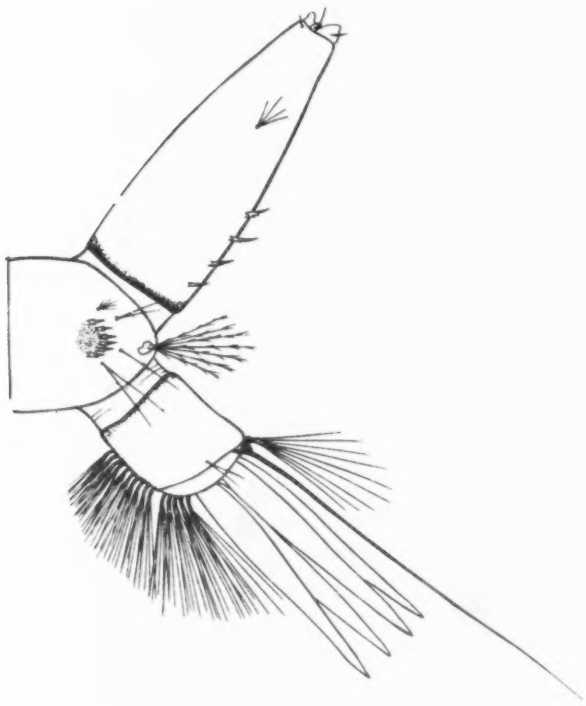
_____

9. The eighth segment has one row of comb scales. The air tube has no pecten, but many hairs or hair tufts.

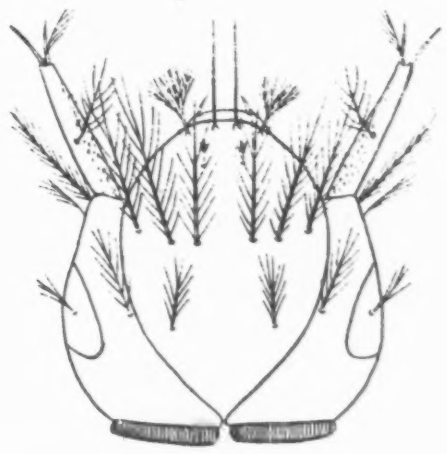


10. The head has a triangular pouch on either side behind the base of each antenna.

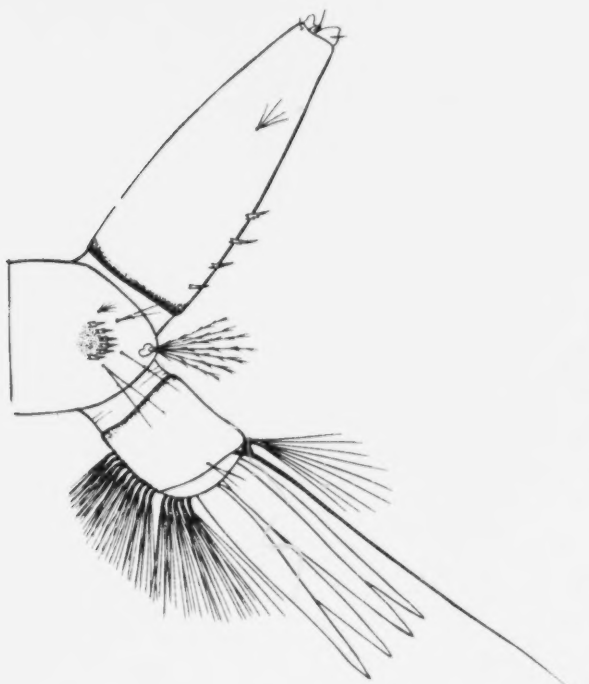
11. The anal segment is completely encircled by a plate pierced by the tufts of the median ventral brush.



12. The head is longer than wide and bears 4 conspicuous hairs on the clypeus and a row of six hairs across the middle of the upper surface.

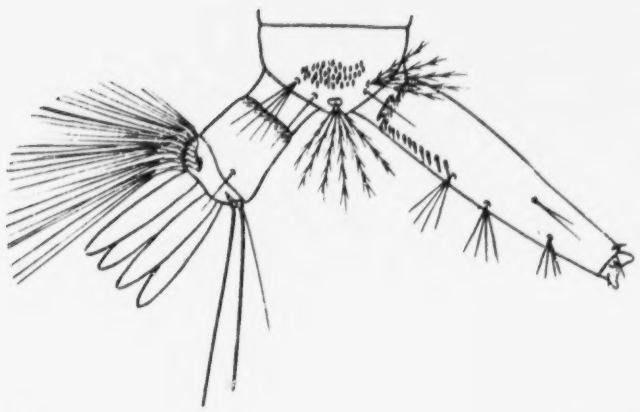


11. The anal segment is completely encircled by a plate pierced by the tufts of the median ventral brush.

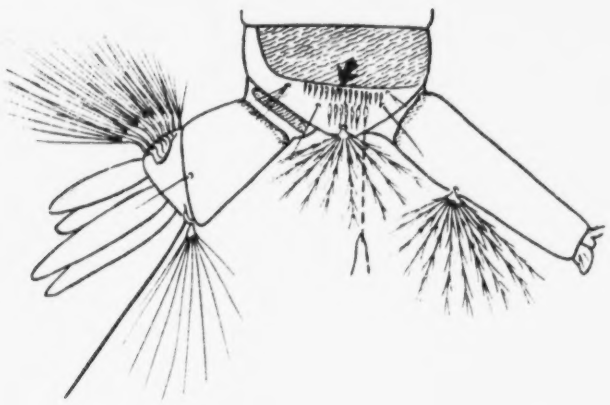


12. The head is longer than wide and bears 4 conspicuous hairs on the clypeus and a row of six hairs across the middle of the upper surface.

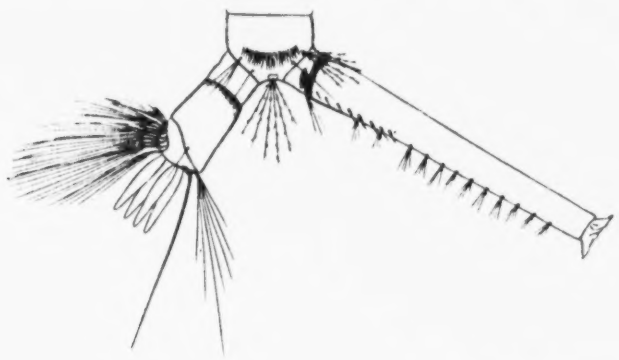
13. The air tube has a pecten and several tufts or hairs on each side.



14. The air tube has no pecten, and the eighth abdominal segment bears 2 rows of comb scales.



15. The air tube has a pecten consisting of several teeth and one tuft near the base on each side.

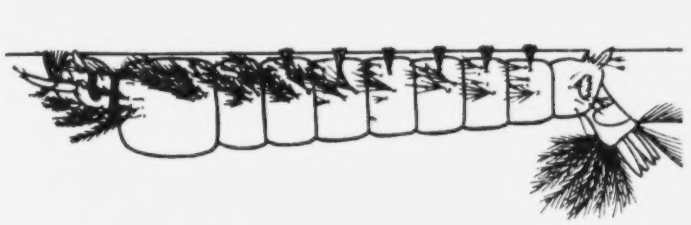


PART V

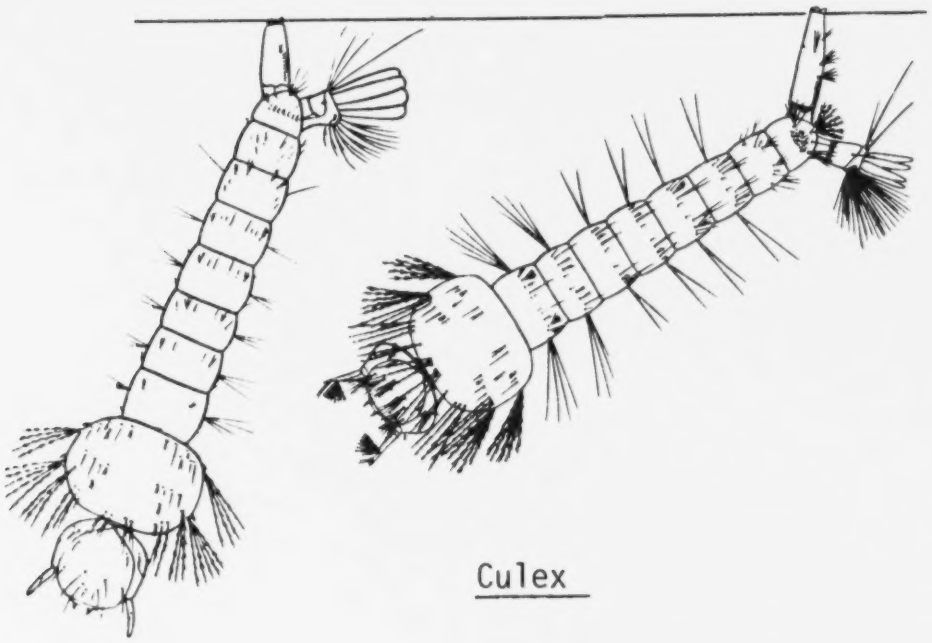
ILLUSTRATED KEY TO SOME COMMON FOURTH STAGE LARVAE OF NORTH AMERICAN MOSQUITOES

One of the most important aspects of mosquito control or eradication programs is correct identification of mosquito larvae. Although there are about 150 species of mosquitoes in North America north of Mexico, usually only a few species are of major importance in any given area. An illustrated key to some of the important species of mosquito larvae is presented on the following pages. Use it to learn characters necessary to identify the most important species in your area.

Accurate identification furnishes important clues regarding the potential disease or pest problem in an area before the adults emerge, and helps pin point exact areas requiring control.



Anopheles



Culex

Aedes

Illustrated Key to Some Important Species of North American Mosquito Larvae

Harry D. Pratt and Chester J. Stojanovich

1. Air tube present; abdomen without palmate hairs (Fig. 1A)..... 2

   Air tube absent; abdomen with palmate hairs (Fig. 1B). Genus Anopheles 34

Fig. 1A

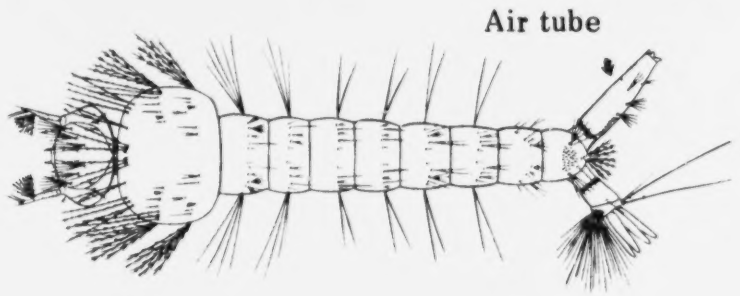
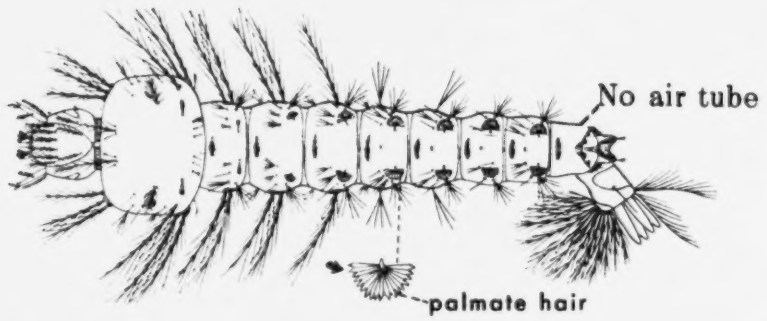


Fig. 1B



2. Air tube strongly tapered with teeth on one side, pecten absent (Fig. 2A)..... Mansonia perturbans

   Air tube not strongly tapered, without teeth on one side, pecten present (Figs. 2B and 2C)..... 3

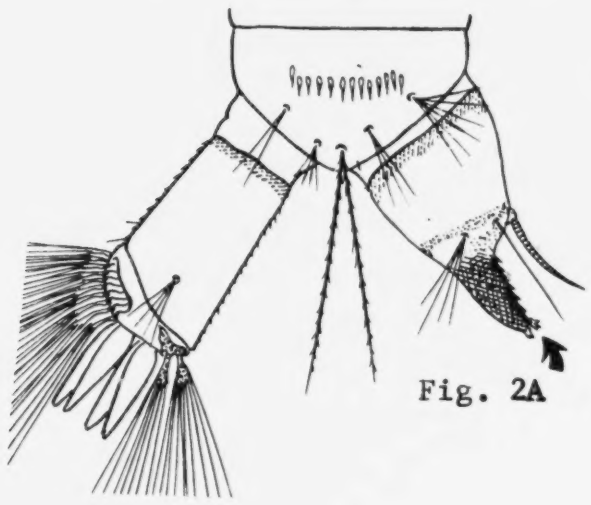


Fig. 2A

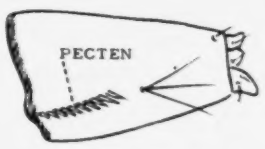


Fig. 2B

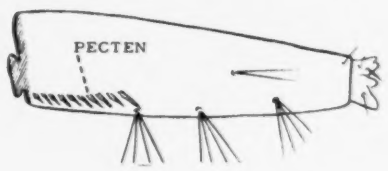


Fig. 2C

3. Air tube with a tuft or hair at base. Genus Culiseta (Figs. 3A and 3B).....4

Air tube with all hairs or hair tufts beyond basal fourth (Figs. 3C and 3D).....7

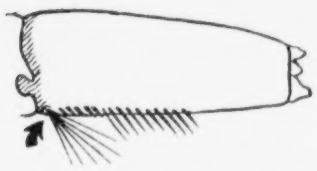


Fig. 3A

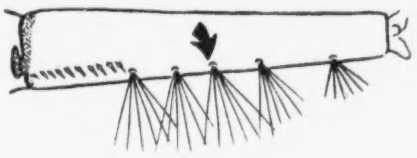


Fig. 3C

Fig. 3B

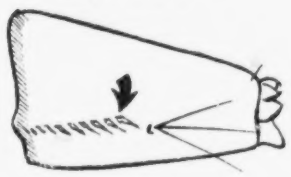


Fig. 3D

4. Air tube with a hair tuft or hair at base and many multiple tufts (Fig. 4A); eighth segment with comb scales in a single row..... .....Culiseta melanura

Air tube with only a single hair tuft near base (Fig. 4B); eighth segment with comb scales in 2 or more rows.....5

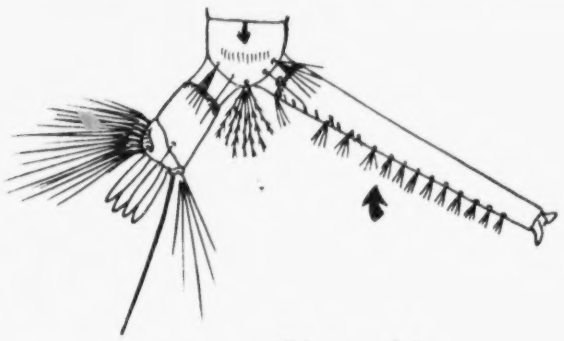


Fig. 4A

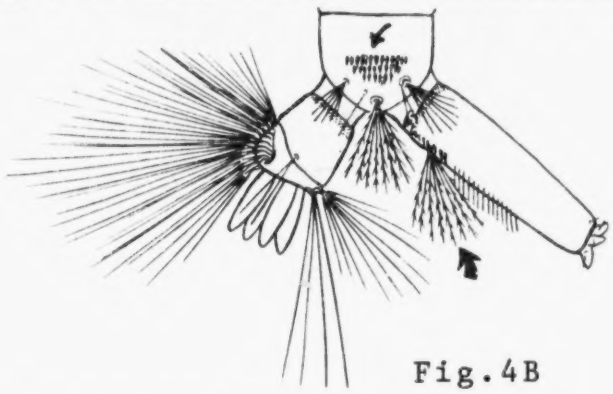


Fig.4B

5. Air tube long and slender, about 6-8 times as long as basal width; pecten of a few teeth near base (Fig. 5A).....Culiseta morsitans

Air tube short and stout, about 3-4 times as long as basal width; pecten of many stout teeth on basal portion and slender, hair-like teeth on outer portion (Fig. 5B).....6

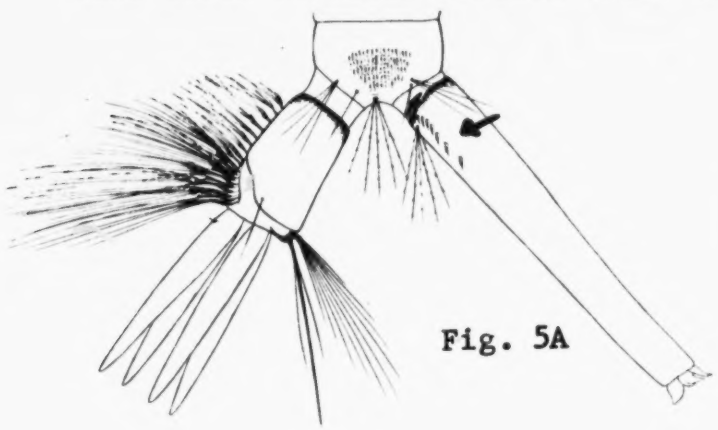


Fig. 5A

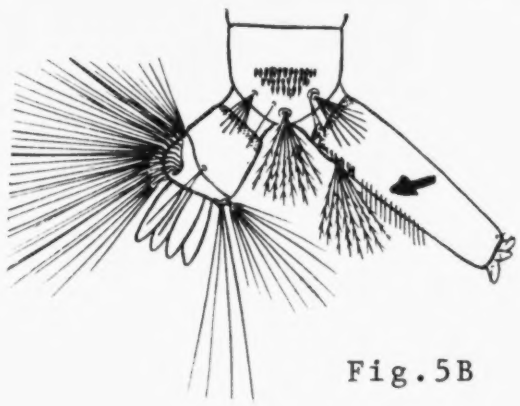


Fig.5B

6. Lateral hair of anal saddle stout, longer than saddle (Figs. 6A and 6C)..... Culiseta inornata

Lateral hair of anal saddle fine, shorter than saddle (Fig. 6B). .....Culiseta incidens

Fig. 6A

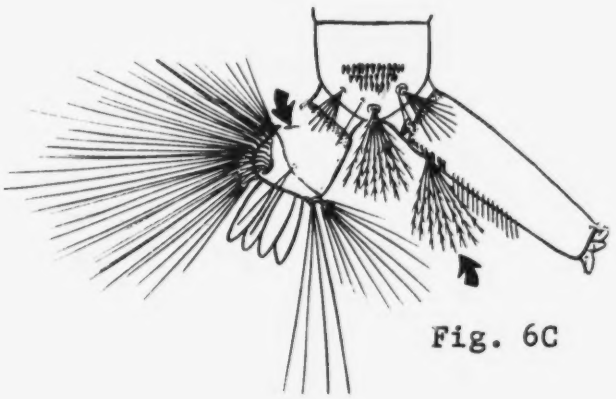


Fig. 6C

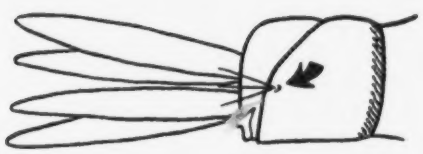


Fig. 6B

7. Air tube with several hairs or hair tufts on each side. Genus Culex (Figs. 7A and 7B)..... 8

Air tube with one hair or hair tuft on each side (Figs. 7C and 7D)..... 15

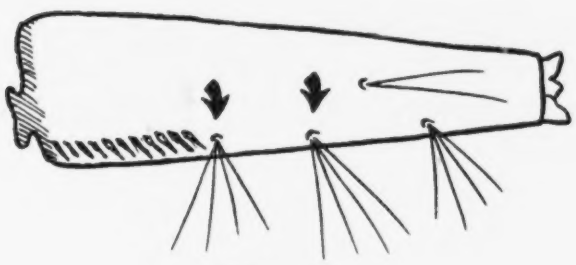


Fig. 7A

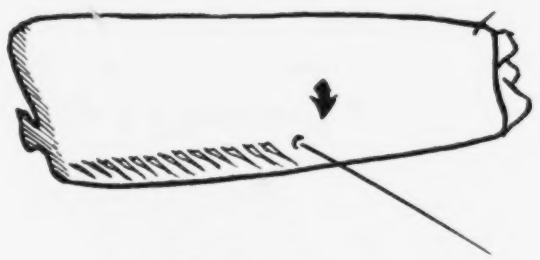


Fig. 7C

Fig. 7B

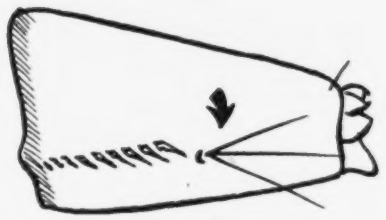


Fig. 7D

8. Antenna with tuft near middle (Fig. 8A); air tube with some single hairs (Fig. 8B)..... Culex restuans

Antenna with tuft beyond middle (Fig. 8C)..... 9

Fig. 8A

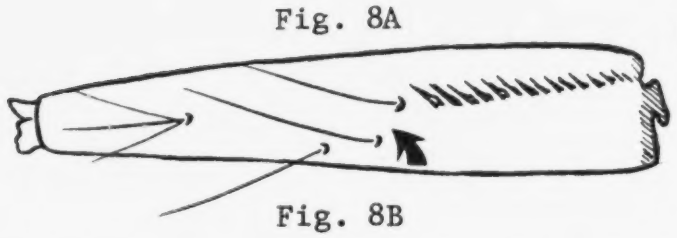


Fig. 8B

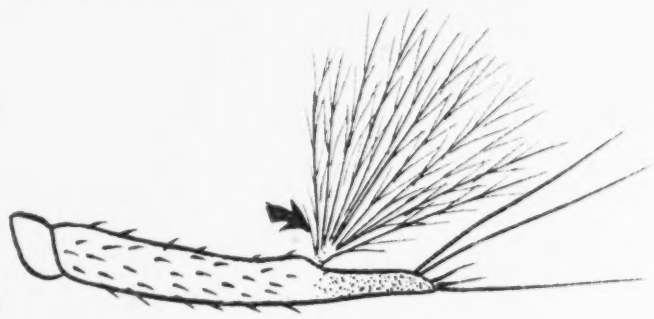


Fig. 8C

9. Air tube with basal tubercles of all hair tufts arranged in a straight line (Fig. 9A)..... Culex tarsalis

Air tube with at least one basal tubercle of a hair tuft or hair out of line with the others (Fig. 9B)..... 10

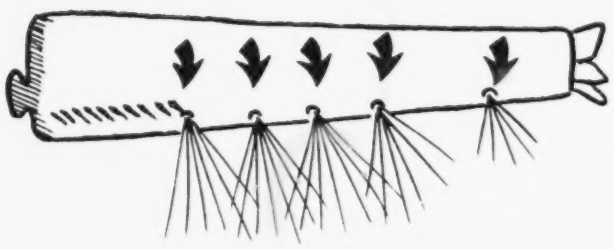


Fig. 9A

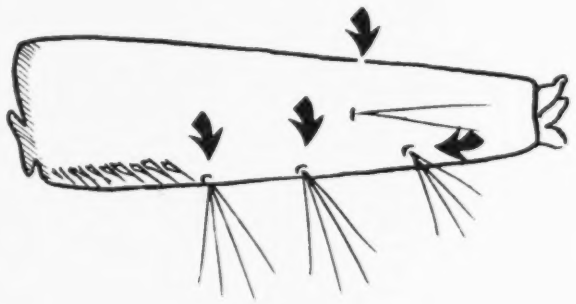


Fig. 9B

10. Air tube shorter and stouter, about 3 to 5.5 times as long as basal width (Fig. 9B)..... 11

Air tube longer and more slender, about 6 to 10 times as long as basal width (Figs. 10A and 10B)..... 12

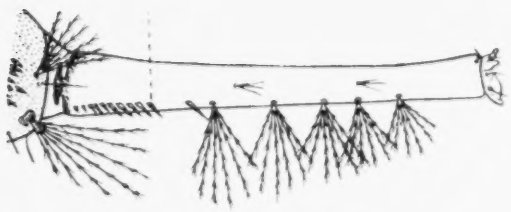


Fig. 10A

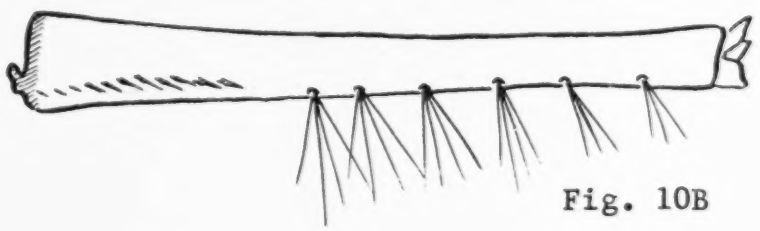


Fig. 10B

11. Lateral hairs of abdominal segments III and IV usually triple; dorsal microsetae toward apex of saddle of anal segment conspicuously larger than those at dorsal middle (Fig. 11A); western species ..... Culex peus

Lateral hairs of abdominal segments III and IV usually double; dorsal microsetae toward apex of saddle of anal segment not conspicuously larger than those at dorsal middle (Fig. 11B); widely distributed throughout U. S. .... Culex pipiens pipiens and Culex pipiens quinquefasciatus

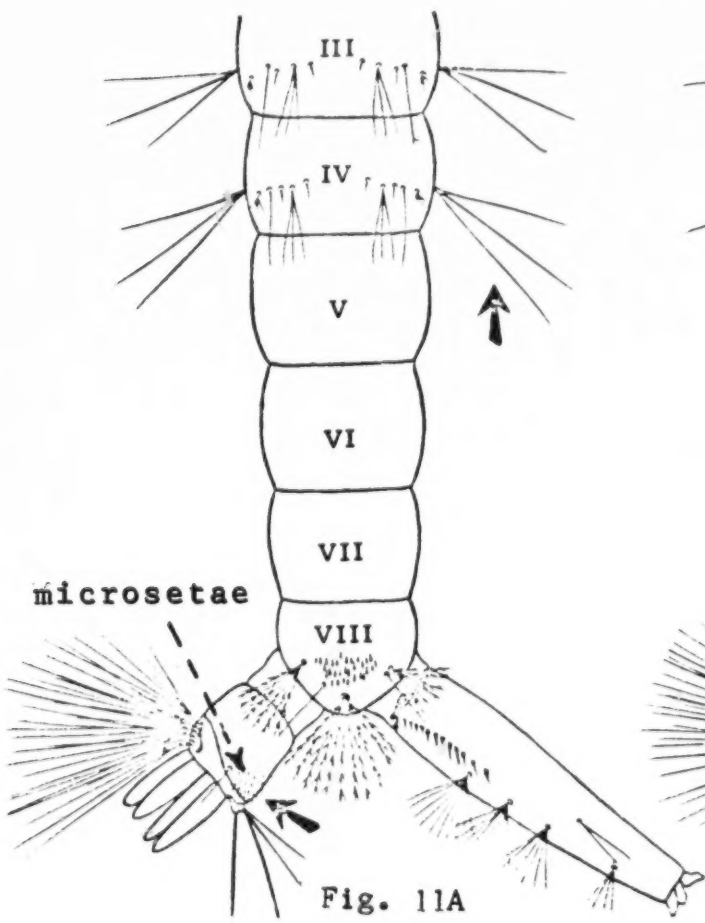


Fig. 11A

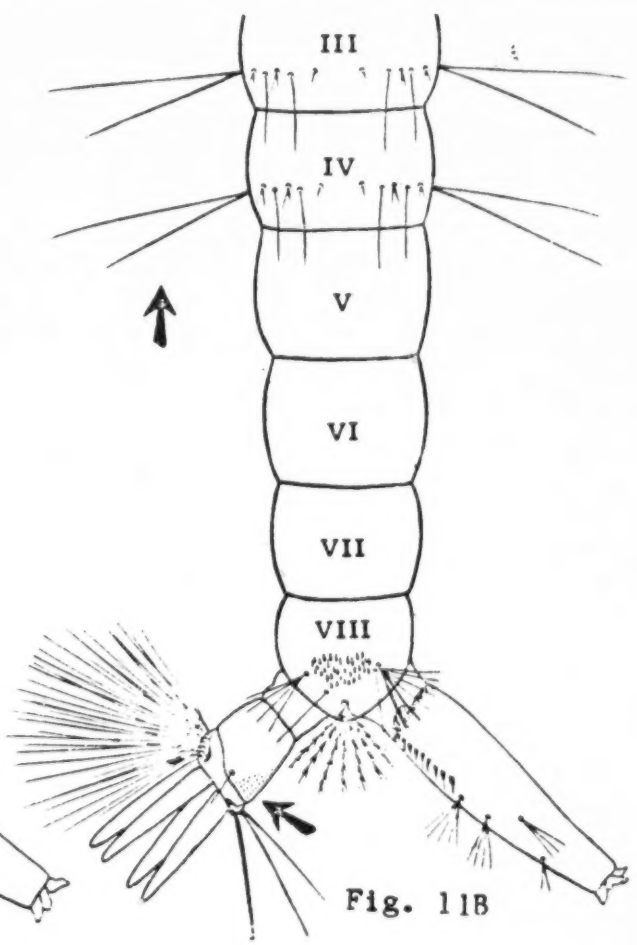


Fig. 11B

12. Lower head hairs single or double (Fig. 12A)..... 13

Lower head hairs with 3 or more branches (Fig. 12B)..... 14

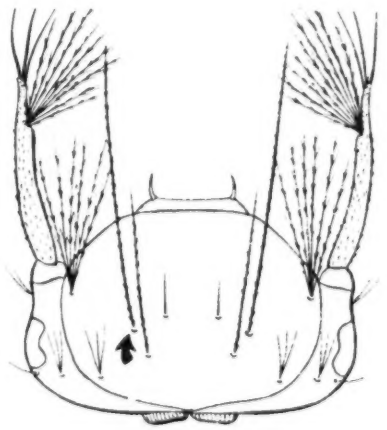


Fig. 12A

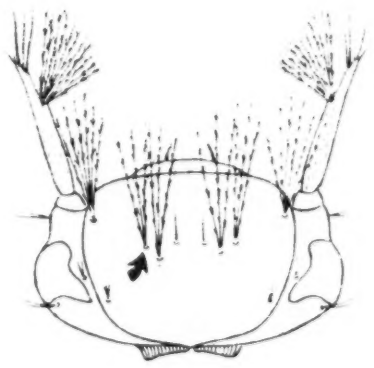


Fig. 12B

13. Upper head hairs short, many branches (Fig. 13A)..... Culex erraticus

Upper head hairs long, single or double (Fig. 13B).... Culex territans

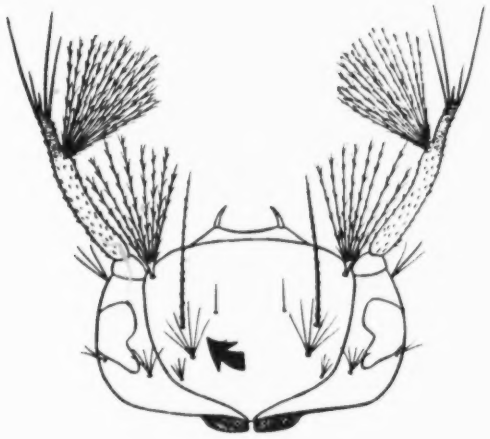


Fig. 13A

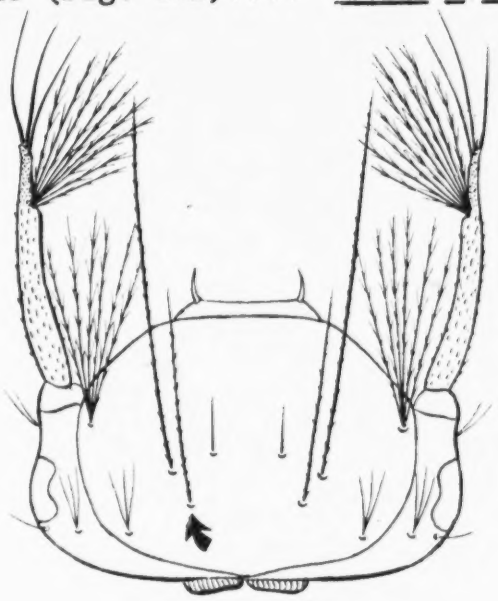


Fig. 13B

14. Thorax densely spiculate (spicules dark); lateral hair of anal segment usually single (Fig. 14A and 14B)..... Culex nigripalpus

Thorax with few or no spicules; lateral hair of anal segment usually double (Fig. 14C)..... Culex salinarius

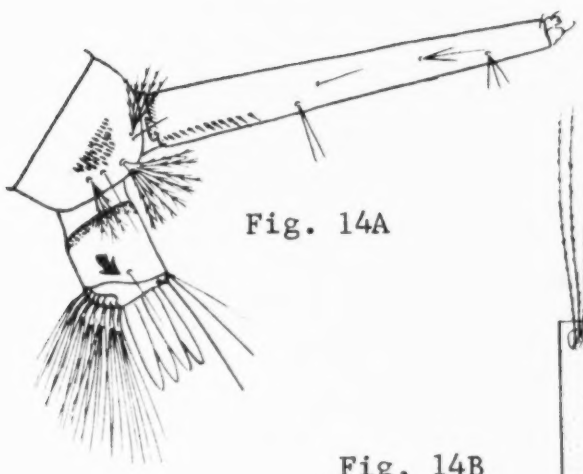


Fig. 14A

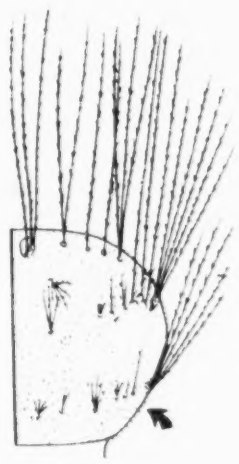


Fig. 14B

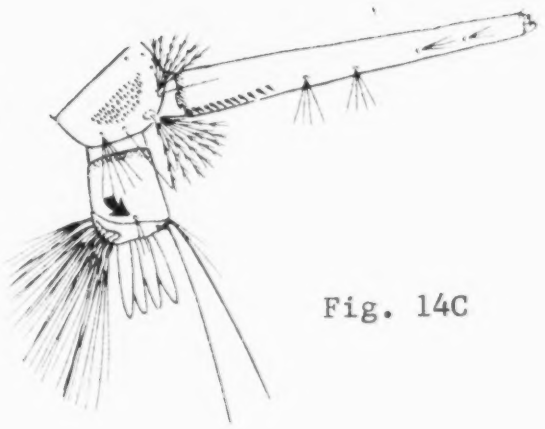


Fig. 14C

15. Anal saddle pierced by anterior tufts of median ventral brush (Fig. 15A); Genus Psorophora 16

Anal saddle not pierced by tufts of median ventral brush (Figs. 15B and 15C); Genus Aedes 18

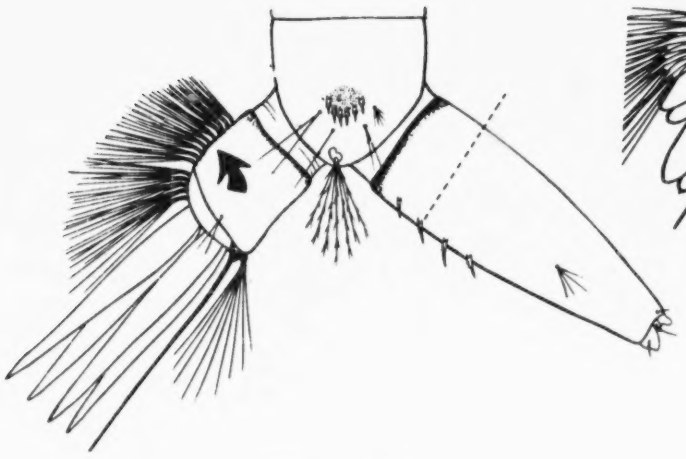


Fig. 15A

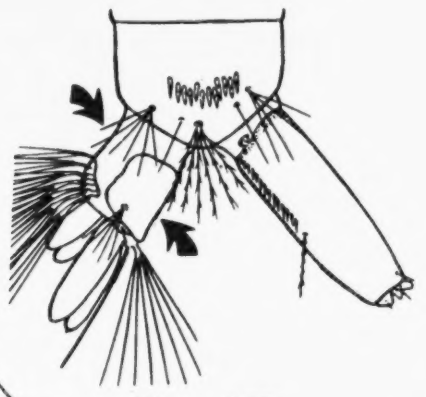


Fig. 15B

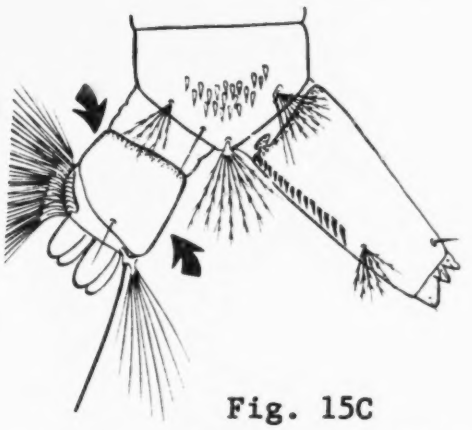


Fig. 15C

16. Air tube with many pecten teeth (Fig. 16A)..... Psorophora ciliata

Air tube with 2-8 pecten teeth (Fig. 16B)..... 17

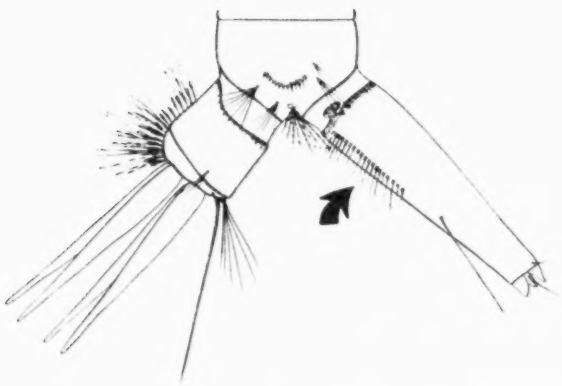


Fig. 16A

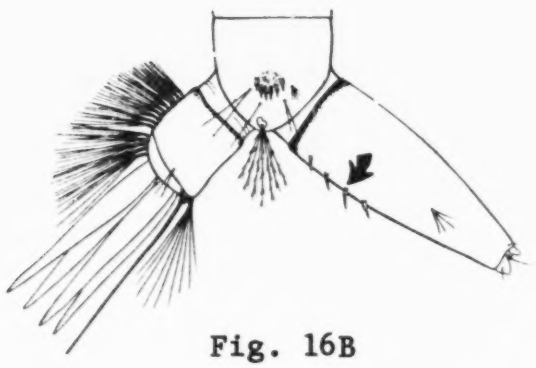


Fig. 16B

17. Antenna short; upper and lower head hairs with 4 to 8 branches (Fig. 17A)..... Psorophora confinnis

Antenna long; upper and lower head hairs with 2 or 3 branches (Fig. 17B)..... Psorophora ferox

Fig. 17A

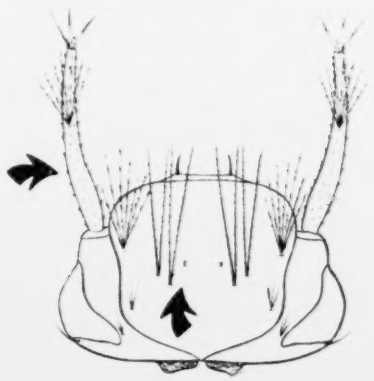


Fig. 17B

18. Distal pecten teeth more widely spaced than basal teeth (Fig. 18A)..... 19

All pecten teeth evenly spaced (Fig. 18B)..... 23

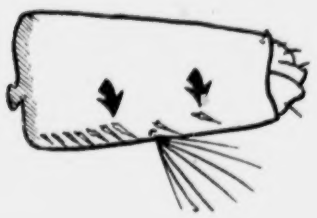


Fig. 18A

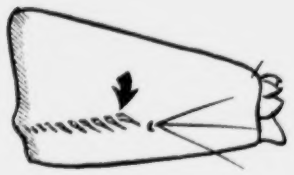


Fig. 18B

19. Hair tuft on air tube inserted before last pecten tooth (Fig. 19A)..... Aedes atropalpus

Hair tuft on air tube inserted after last pecten tooth (Fig. 19B)..... 20

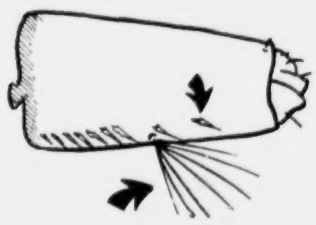


Fig. 19A

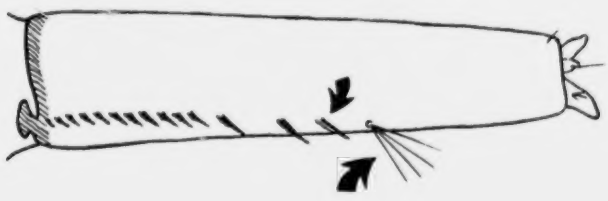


Fig. 19B

20. Pecten teeth extending beyond middle of air tube (Fig. 20A); anal saddle completely encircling snal segment; most abundant in western United States..... Aedes nigromaculis

Pecten teeth extending about to middle of air tube (Fig. 20B); anal saddle not completely encircling anal segment..... 21

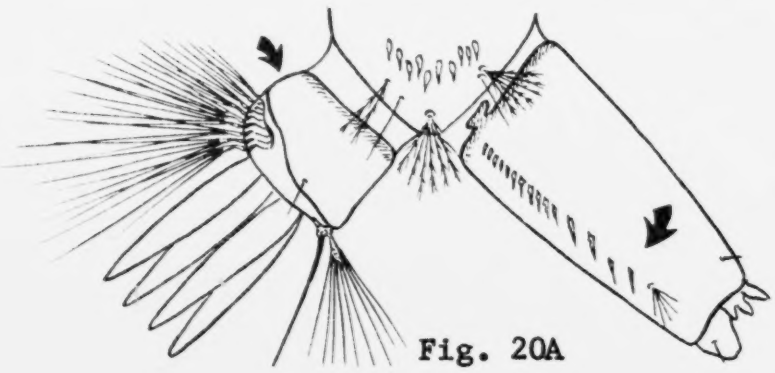


Fig. 20A

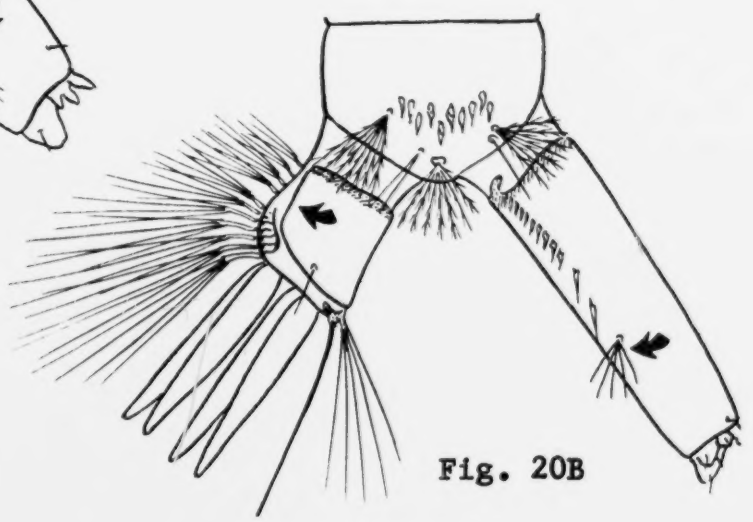


Fig. 20B

21. Air tube long and slender, 4 to 5 times as long as basal width (Fig. 21A)..... Aedes excrucians

Air tube shorter and stouter, 2 to 4 times as long as basal width (Fig. 21B)..... 22

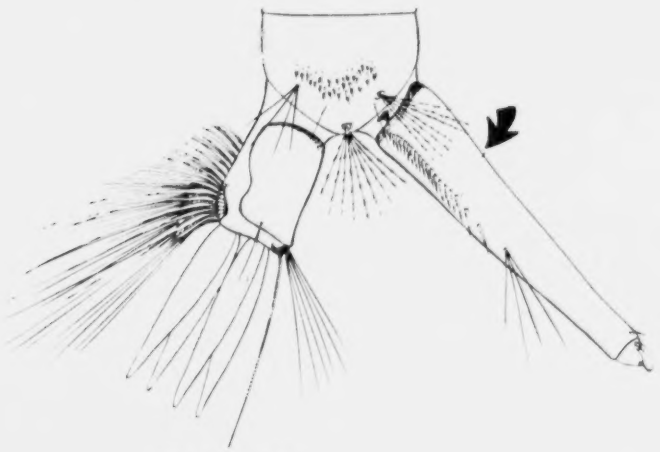


Fig. 21A

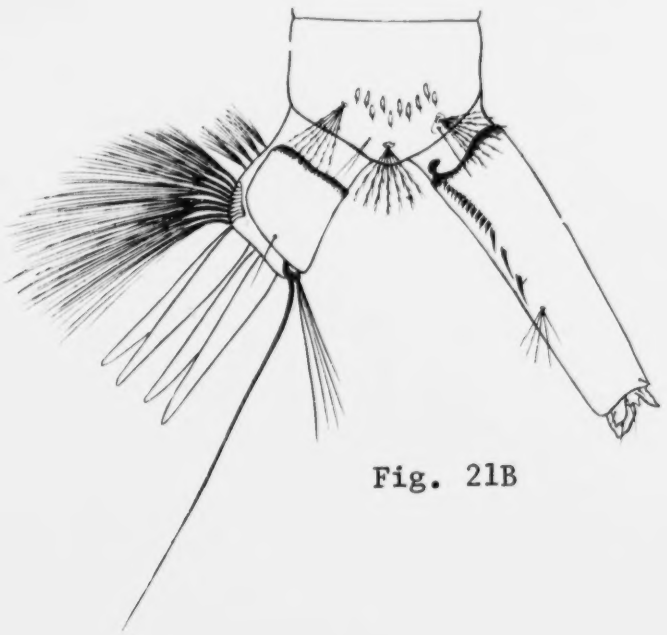


Fig. 21B

22. Upper, lower and preantennal head hairs inserted almost in a straight line (Fig. 22A)..... Aedes cinereus

Upper, lower and preantennal head hairs not inserted in a straight line (Fig. 22B)..... Aedes vexans

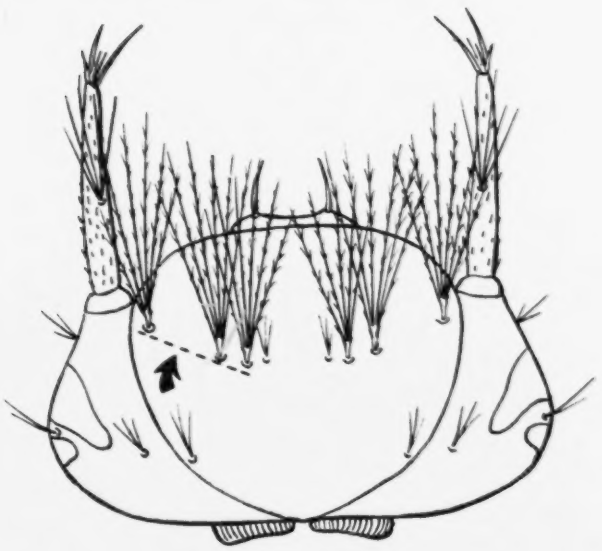


Fig. 22A

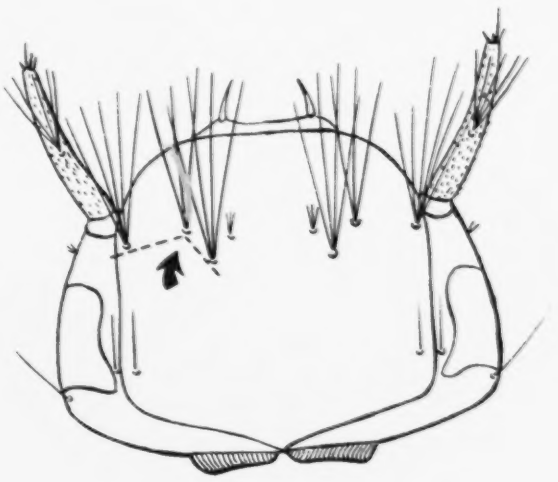


Fig. 22B

23. Anal segment completely encircled by saddle (Fig. 23A)..... 24

Anal segment not completely encircled by saddle (Fig. 23B)..... 26

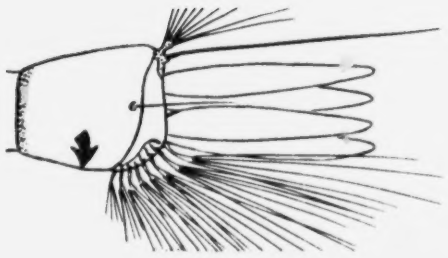


Fig. 23A

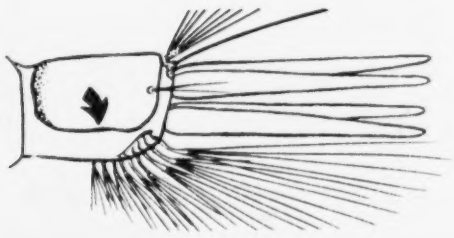


Fig. 23B

24. Comb of 4-6 scales in a single row (Fig. 24A).....Aedes atlanticus

Comb of many scales in 2 or more rows (Fig. 24B).....25

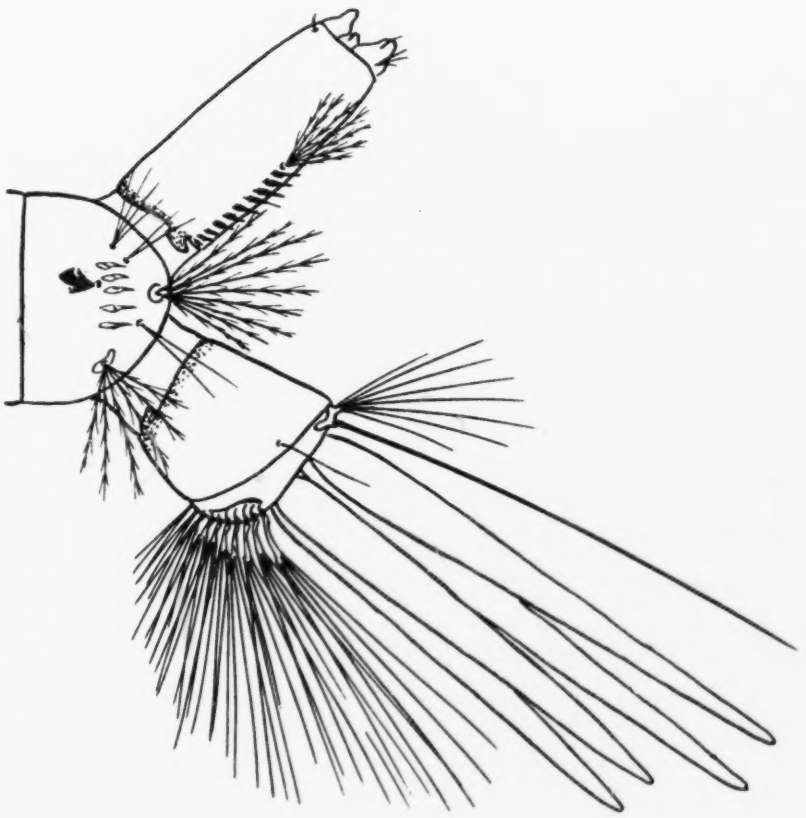


Fig. 24A

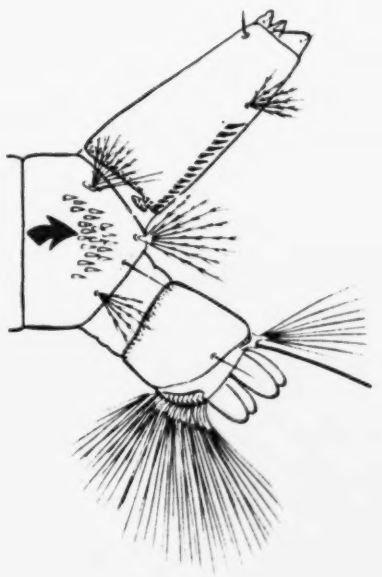


Fig. 24B

25. Comb scale rounded apically (Fig. 25A).....Aedes taeniorhynchus

Comb scale thorn-like (Fig. 25B).....Aedes sollicitans

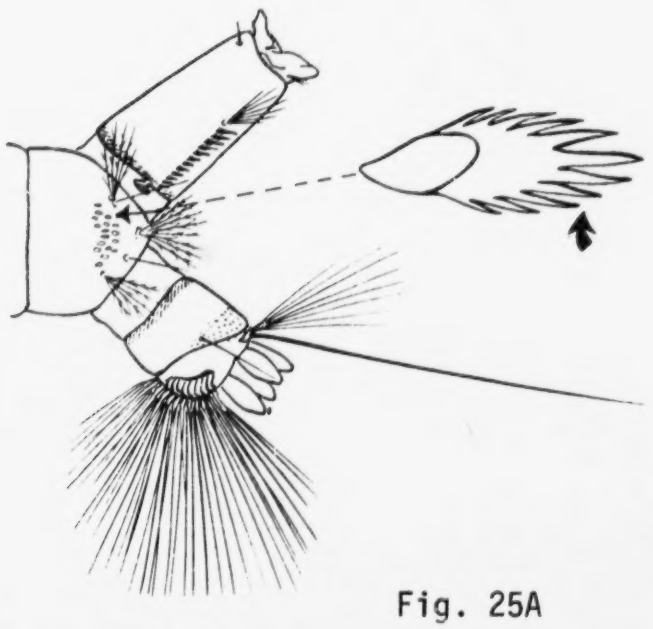


Fig. 25A

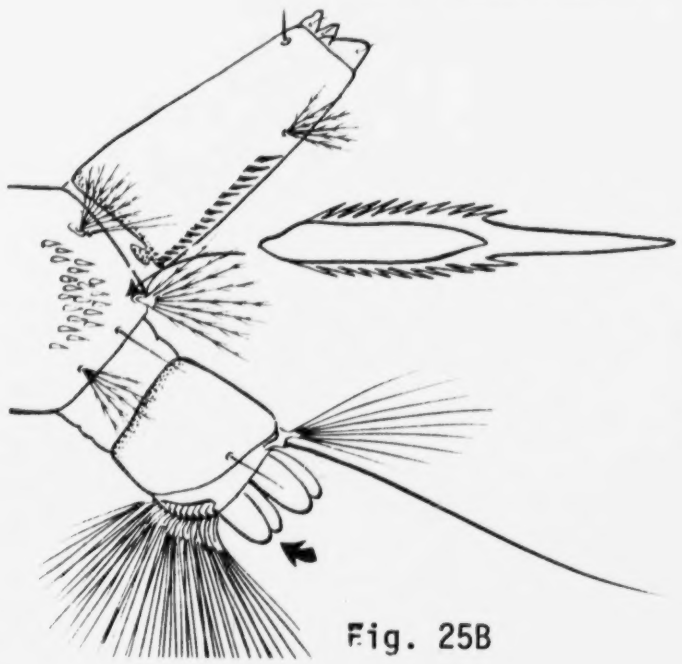


Fig. 25B

26. Antennal shaft smooth, antennal hair single (Fig. 26A)..... 27

Antennal shaft rough, antennal hair with 2 or more branches (Fig. 26B)..... 29

Fig. 26A

Fig. 26B

27. Comb scales in 2 or more rows; Pacific Coast species (Fig. 27A)..... Aedes sierrensis

Comb scales in a single or irregular double row; eastern species (Fig. 27B)..... 28

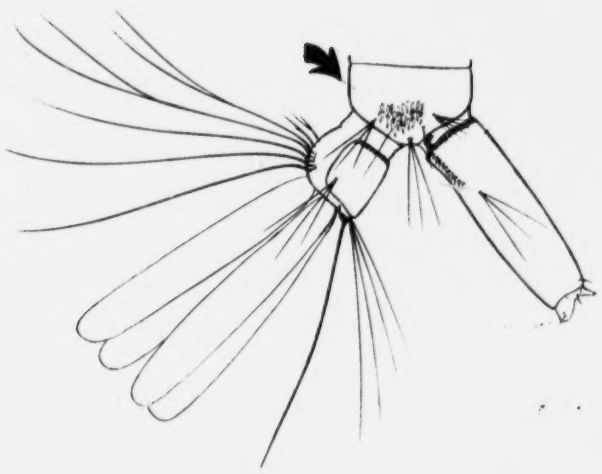


Fig. 27A

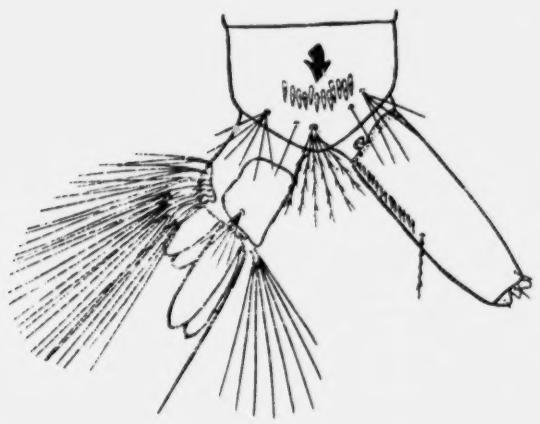


Fig. 27B

28. Preantennal and lower head hairs single; thorax with 4 long, curved lateral spines at base of hairs on mesothorax and metathorax; comb scales thorn-shaped with a strong median spine and stout lateral denticles; anal gills long, equal (Figs. 28A and 28B)..... Aedes aegypti

Preantennal hair multiple, lower head hair single to triple; thorax with 4 short spines or tubercles at base of hairs; comb scales slipper-shaped, evenly tapered with a fringe but no stout lateral spines; anal gills unequal, 2 long and 2 short (Figs. 28C and 28D)..... Aedes triseriatus

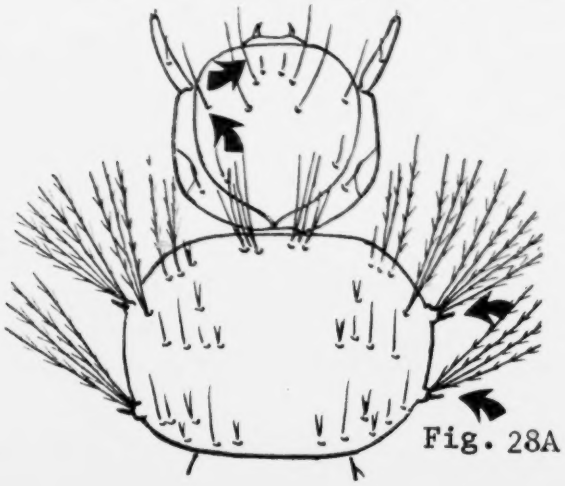


Fig. 28A

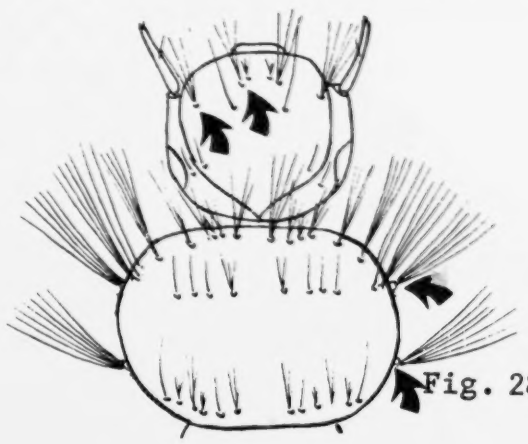


Fig. 28C

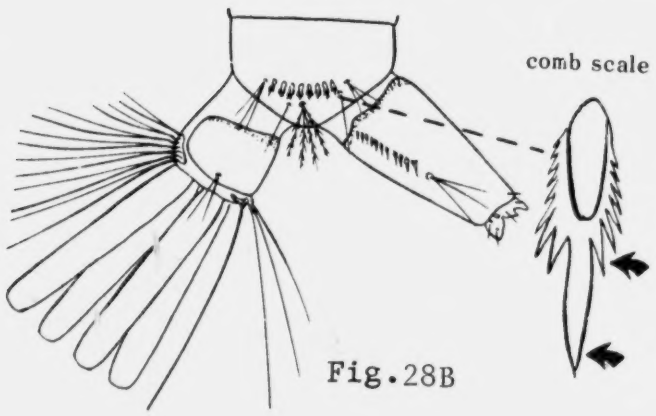


Fig. 28B

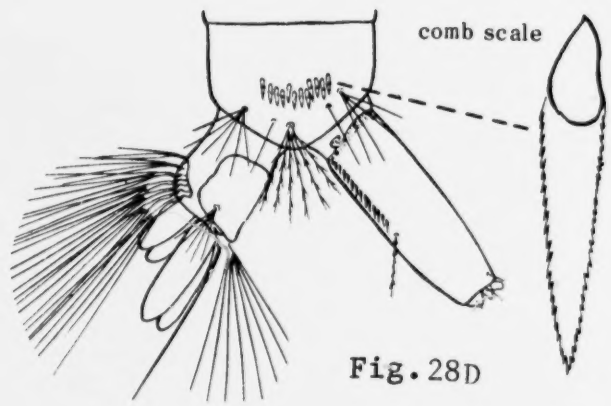


Fig. 28D

29. Air tube long and slender, 4 to 5 times as long as basal width (Fig. 29A)..... Aedes fitchii

Air tube short and stout, 2 to 4 times as long as basal width (Fig. 29B)..... 30

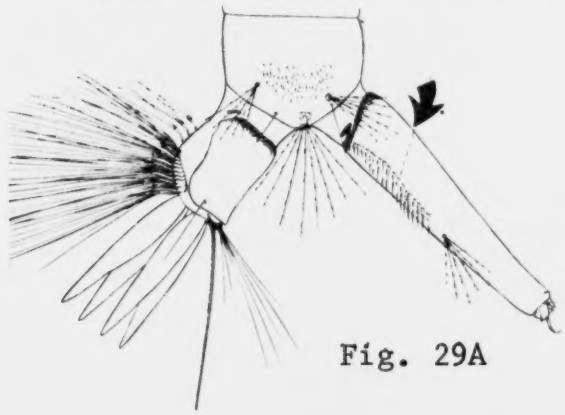


Fig. 29A

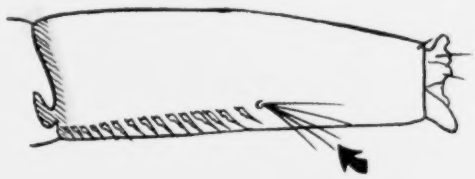


Fig. 29B

30. Upper head hairs single to triple (Fig. 30A)..... 31

Upper head hair with 4 or more branches (Fig. 30B)..... 33

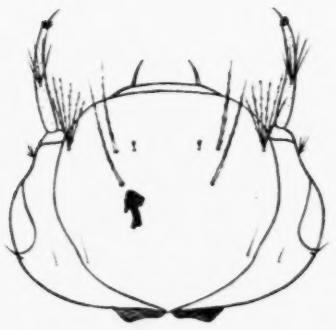


Fig. 30A

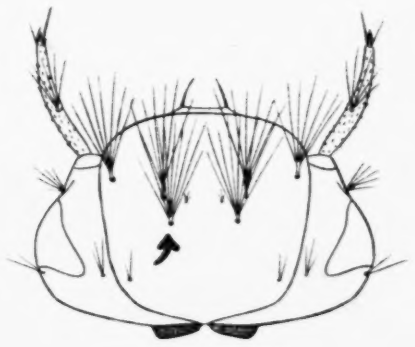


Fig. 30B

31. Hair tuft on air tube inserted slightly beyond middle; anal gills typically short and bud-like (Fig. 31A)..... ..... Aedes dorsalis and Aedes melanimon

Hair tuft on air tube inserted slightly before middle; anal gills long and pointed, often as long as, or longer than, anal saddle (Fig. 31B)..... 32

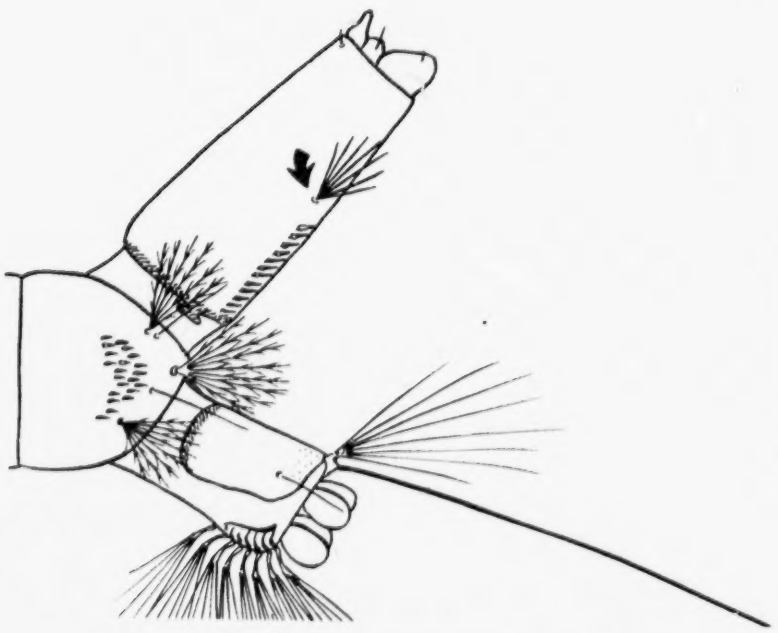


Fig. 31A

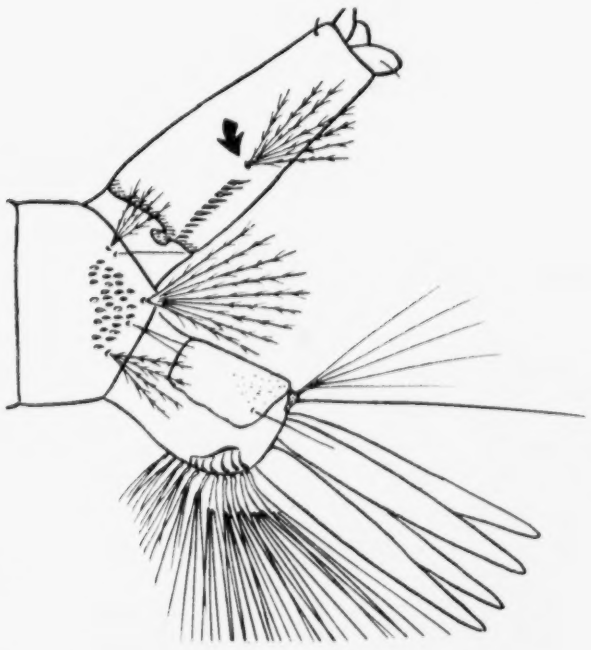


Fig. 31B

32. Upper head hair usually double (Fig. 32A)..... Aedes stimulans

Upper head hair usually single (Fig. 32B)..... Aedes communis

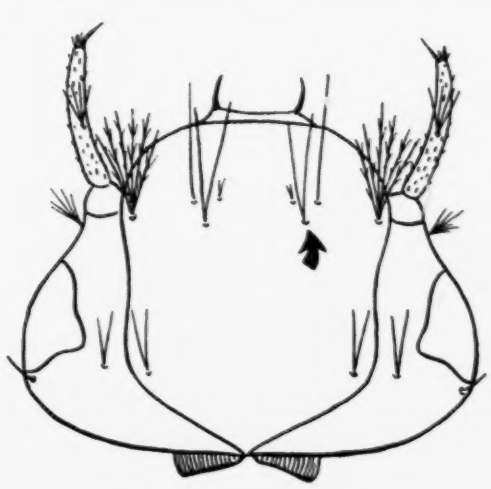


Fig. 32A

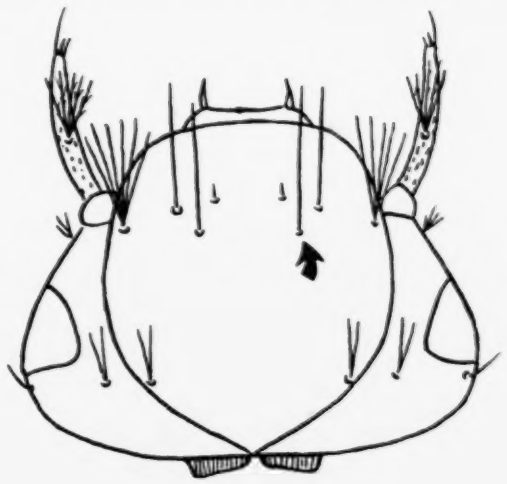


Fig. 32B

33. Air tube 2.5 to 3 times as long as basal width; anal gills shorter than anal saddle; Atlantic Coast from Virginia north; typically in brackish water (Fig. 33A)..... Aedes cantator

Air tube 3 to 4 times as long as basal width; anal gills as long as, or longer than, anal saddle; widely distributed in United States; fresh water species (Fig. 33B)..... Aedes canadensis

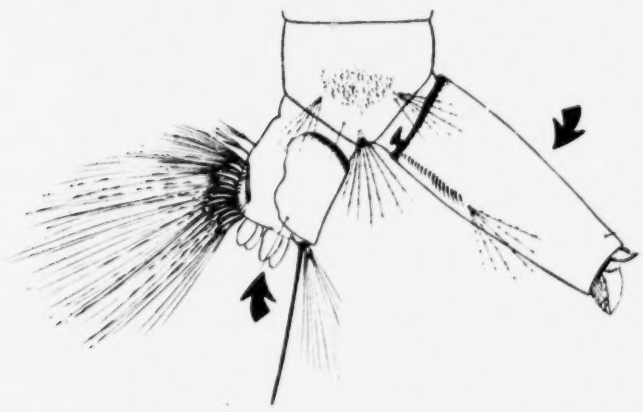


Fig. 33A

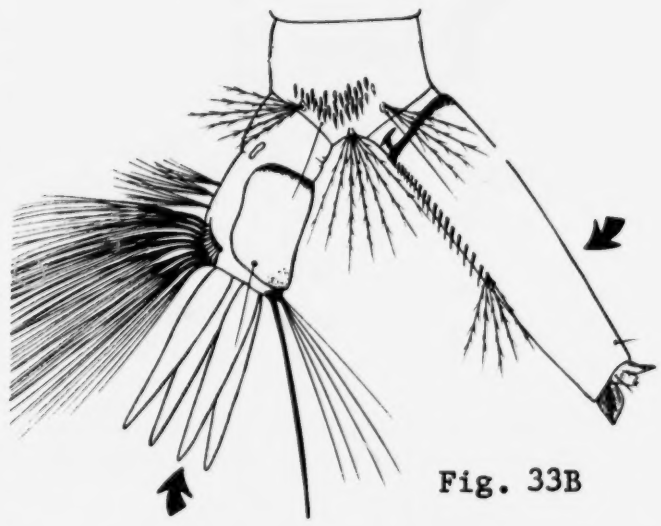


Fig. 33B

34. Outer clypeal hairs simple (Fig. 34A) 35

Outer clypeal hairs densely branched (Fig. 34B 36

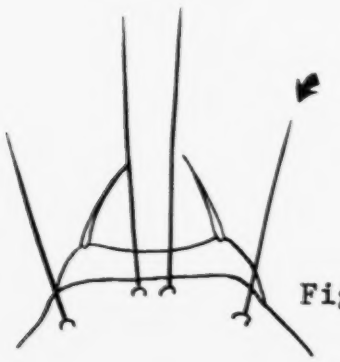


Fig. 34A

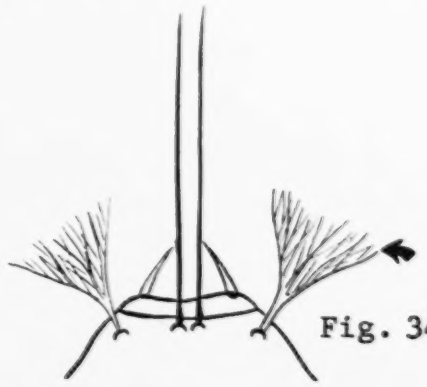


Fig. 34B

35. Spiracular plate without well-developed tails; western species, from Texas and Kansas to Oregon (Fig. 35A) ....Anopheles franciscanus

Spiracular plate with well-developed tails; South Central United States, Alabama to New Mexico (Fig. 35A) .....
..... Anopheles pseudopunctipennis

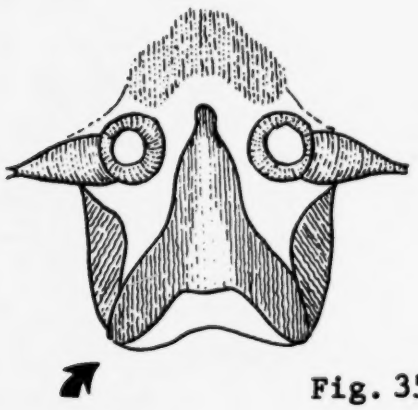


Fig. 35A

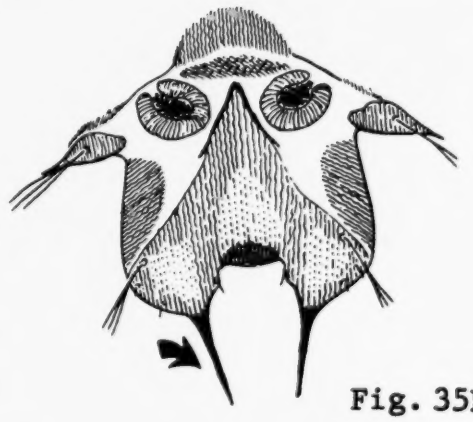


Fig. 35B

36. Abdominal segments IV and V with both hair 0 and hair 2 large and multiple (Fig. 36A)..... Anopheles crucians

Abdominal segments IV and V with hair 0 rudimentary or absent; hair 2 single to multiple (Figs. 36B and 37B)..... 37

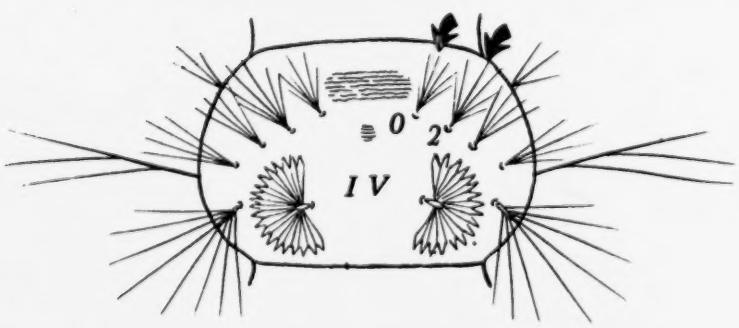


Fig. 36A

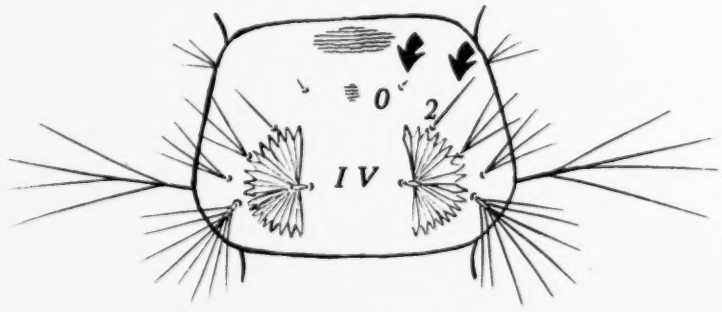


Fig. 36B

37. Inner clypeal hairs separated by at least width of a basal tubercle of one hair; abdominal segments IV and V with hair 2 single (Figs. 37A and 37B)..... Anopheles quadrimaculatus

Inner clypeal hairs separated by less than width of a basal tubercle of one hair; abdominal segments IV and V with hair 2 double to many-branched (Figs. 37C and 37D)..... 38

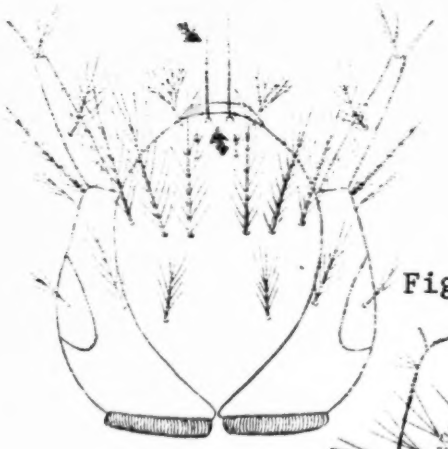


Fig.37A

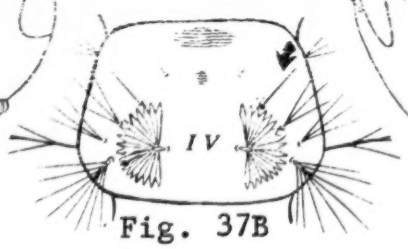


Fig. 37B

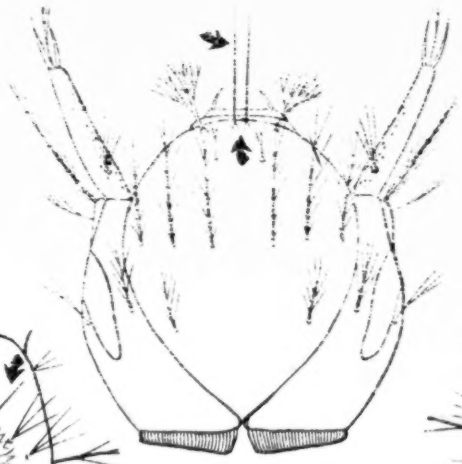


Fig.37C

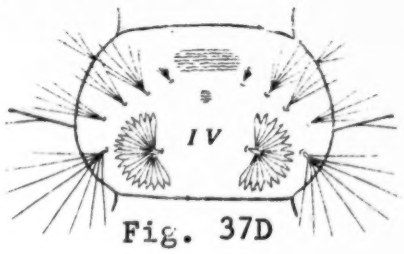


Fig. 37D

38. Abdominal segments IV and V with 2 tergal plates; hair 2 double; all United States (Fig. 38A) ..... Anopheles punctipennis

Abdominal segments IV and V with 4 tergal plates; hair 2 with two to many branches; found from Colorado and New Mexico west to the Pacific (Fig. 38B) ..... Anopheles freeborni

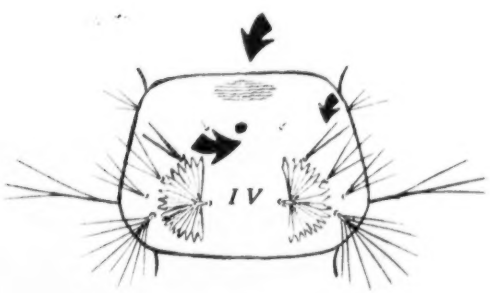


Fig. 38A

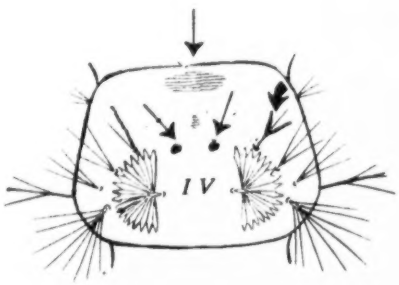


Fig. 38B

Glossary

abdomen - the third major, or most posterior, region of the insect body, composed of eight segments plus the terminal segments.

abdominal segment - one of the subdivisions of the abdomen, usually referring to one of the first eight divisions of the abdomen.

accessory tergal plate - small, paired plate behind anterior or posterior tergal plates on abdominal segments.

adult - the fourth stage in mosquito development.

air tube - a cylindrical structure arising from the eighth abdominal segment of culicine larvae, used for respiration.

anal gills - membraneous terminal structures on the anal segment, not used for breathing as in fishes, but for maintaining the chemical balance in the mosquito "blood".

anal saddle - a hardened, or sclerotized, plate on the anal segment.

anal segment - the structure at the end of culicine mosquito larva in which the alimentary canal is located, terminating in the anus or posterior opening of the canal.

anopheline larva - malaria mosquito larvae, genus Anopheles, without air tube and with palmate hairs.

antenna - a tubular appendage on the head, often called a "feeler".

antennal hair - a single to many-branched hair tuft on the shaft of the antenna, not at the tip of the antenna.

anterior flap - the anterior plate on the spiracular apparatus.

anterior tergal plate - the large anterior plate on each abdominal segment.

apical spine - a spine at the tip of some part of the mosquito body, for example, the elongated central portion of a comb scale, as in Aedes aegypti.

aquatic insect - insect which lives in water.

caudal hair - hairs on the anal segment.

comb - a group of scales on the eighth abdominal segment.

comb scales - tiny structures arising from the integument of the eighth abdominal segment, with a characteristic shape in each species of culicine mosquito.

dorsal saber - the top, or dorsal, pointed structure at tip of the antenna.

egg - the first stage in mosquito development.

frontal hair - one of a group of 6 hairs, Nos. 5, 6, 7, located on middle of dorsal surface of head.

head - the first, or most anterior, region of the insect body.

inner clypeal hair - hair 2, near middle of anterior margin of clypeus.

inner frontal hair - hair 5, the middle pair of frontal hairs.

integument - the external covering, or "skin" of the body.

larva - the second stage in mosquito development.

lateral hair - a hair on the side, either of the thorax, abdomen, or anal segment.

lateral plate - a hardened, or sclerotized, plate on the eighth abdominal segment.

lateral spine - a spine on the side, variously used, as for example on the thorax, or on the side of the apical spine on a comb scale.

leaflet - one element of a palmate hair.

lower head hair - one of the hairs on the upper surface of the head.

median plate - the middle plate of the spiracular apparatus.

median ventral brush - a fan-shaped group of hairs arising near the posterior margin of the underside of the anal segment on the middle (ventral) line.

mesothorax - the second part of the thorax.

metathorax - the third part of the thorax.

middle frontal hair - hair 6.

mouth brush - a brush of hairs arising on either side of the mouth under the outer clypeal hairs.

occipital hairs - Nos. 8 and 9.

outer clypeal hair - the lateral pair of hairs on anterior margin of clypeus at anterior end of head, No. 3.

palmate hair - float hairs on the abdomen of the malaria mosquito larva, given the name "palmate" after the palm frond or palm of the hand.

pecten - a comb-like row of tiny teeth on the air tube of the culicine mosquito.

pleural group - one of 3 groups of hairs, Nos. 9-12, arising from common tubercles on underside of thorax.

post clypeal hair - hair 4, behind the inner clypeal hair, near anterior end of head.

posterior plate - one of a pair of plates on posterior end of spiracular apparatus.

posterior tergal plate - the small rounded plate on some abdominal segments, behind anterior tergal plate.

preantennal hair - a hair on the head near the base of the antenna.

preclypeal hairs - one of a pair of hairs on the clypeus, hair 1.

prothorax - the first part of the thorax.

pupa - the third stage in the life history of a mosquito, the stage between the larva and the adult.

shaft - the tubular part of the antenna.

spicule - tiny projections from the integument of "skin" of the mosquito larva somewhat resembling the "five o'clock shadow" on a man's face.

spiracle - one of two circular openings of respiratory system on spiracular apparatus.

spiracular apparatus - the group of plates surrounding the spiracles near tip of abdomen.

submedian prothoracic hair - No. 1 prothoracic hair, nearest mid-line along anterior margin of thorax.

sutural hair - hair 8, mesal to suture on head.

tail - a slender, hardened extension of posterior plate of spiracular apparatus.

tergal plate - a hardened plate on the dorsal surface of abdominal segment.

thorax - the middle major region of the insect body.

trans-sutural hair - hair 9, lateral to suture on head.

upper head hair - one of the hairs on the upper surface of the head.

ventral saber - the ventral pointed structure at tip of antenna.

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